Should Patients Be Able to Follow Commands Prior to Extubation?

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The determination of optimal timing of liberation from mechanical ventilation requires a thorough assessment of multiple variables that can result in extubation failure. It is estimated that 5–20% of extubations fail. Traditional weaning parameters fail to predict extubation failure accurately, and attention has thus turned to improvements in extubation decision making through assessment of elements that may result in inability to protect the airway, such as excessive respiratory secretions, inadequate cough, and depressed mental status. Extubation is particularly controversial in patients with depressed mental status and inability to follow commands. When looking at univariate analyses, the reported studies are relatively evenly divided among those that did and did not find that inability to follow commands (ie, abnormal mental status) increases the risk of extubation failure. In addition, although extubation failure is a risk factor for poor overall outcome in heterogeneous populations, its impact on the patient failing with neurologic dysfunction has not been adequately determined. One limiting factor in all reported studies is how "inability to follow commands" is defined. The majority of studies use the Glasgow coma score, but this is difficult to determine in the intubated patient. Moreover, using the cutoff of Glasgow coma score ≥ 8, favored by many authors, is questionable, as some patients with higher scores may be unable to follow commands. Currently it is agreed that many patients who are unable to follow commands, but have the ability to clear pulmonary secretions, can be safely extubated. A prospective, randomized trial using a more specific definition of "following commands" would certainly help remove some of the uncertainty in this patient population. *Key words: mechanical ventilation; extubation; weaning*. [Respir Care 2010;55(1):56–62]

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Introduction

The determination of optimal timing of liberation from mechanical ventilation requires a thorough assessment of multiple variables that can result in extubation failure. Despite the best efforts of clinicians, it is estimated that 5–20% of extubations fail.[1] Evidenced-based guidelines emphasize the importance of protocol-directed formal spontaneous breathing trials (SBTs) on minimal ventilator support as an aid in determining the feasibility of ventilator weaning.[2] While SBTs allow for assessment of ongoing need for ventilatory support, they fail to address the important issue of the need for an artificial airway. Given that traditional weaning predictors do not accurately predict extubation failure,[3] attention has turned to improvements in extubation decision making through assessment of elements that may result in inability to protect the airway, such as excessive respiratory secretions, inadequate cough, and depressed mental status. Extubation is particularly controversial in patients with depressed mental status and inability to follow commands, and will be the focus of this paper. We will review the impact of delayed extubation versus re-intubation on outcomes, and the literature supporting delayed extubation of patients with impaired neurologic status, and review and make a counter-argument to the literature supporting the safety of extubation in patients with depressed mental status.

Impact of Delayed Extubation Versus Re-intubation

Much of medicine is an attempt to balance risk and benefit of a particular course of action. The timing of extubation in the neurologically impaired patient is a prime example of this, as both prolonged intubation and extubation failure have been associated with harm. Coplin and colleagues reported on a prospective cohort of intubated brain-injured patients at their institution.[4] Over 25% of the patients experienced delayed extubation after meeting standard weaning criteria. They found that patients with delayed extubation had more pneumonias (38% vs 21%, $P < .05$); longer intensive care unit (ICU) stay (median 8.6 d vs 3.8 d, $P < .001$); longer hospital stay (median 19.9 d vs 13.2 d, $P = .009$); higher hospitalization costs (median \$41,824 vs \$70,881, $P < .001$); and higher in-hospital mortality (12.1% vs 27%, $P = .04$).

While it is clear that delaying extubation is associated with increased morbidity and mortality, the medical literature also demonstrates harm from extubation failure. Over 55 studies, involving more than 30,000 patients, suggest that the overall rate of extubation failure is approximately 12% (range 2–25%).[5] These studies have demonstrated increased ICU and hospital mortality in patients requiring re-intubation within 24–72 hours of extubation, with mortality as much as 50% greater in general surgical, medical, and multidisciplinary ICU patients.[5] In those surviving to hospital discharge, morbidity was affected as well. One study from a medical ICU found that re-intubation resulted in an average 12 additional days of mechanical ventilation, 21 ICU days, 30 hospital days, and an increased need for tracheostomy and post-acute-care hospitalization.[6] Interestingly, while patients requiring re-intubation tend to be sicker, multivariate analyses have shown that premorbid health status, severity of illness, and complications directly associated with re-intubation do not explain the increased mortality associated with extubation failure.[7] A direct correlation between increasing time to re-intubation and mortality has led some authors to suggest that clinical deterioration prior to reinstitution of mechanical ventilatory support is responsible for the increased mortality associated with extubation failure.[8]

Clinicians often find it useful to differentiate between weaning failure (inability to adequately oxygenate and ventilate without mechanical ventilatory support) and extubation failure (inability to maintain a patent airway once the artificial airway is removed). Assessment of ability to wean from mechanical ventilatory support is similar in patients with and without neurologic dysfunction; however, assessment of risk of extubation failure is less well established. Multiple etiologies can result in extubation failure, for which many neurologically impaired patients are at increased risk.

A higher rapid shallow breathing index, positive fluid balance in the 24 hours prior to extubation, and pneumonia as the initial reason for intubation and mechanical ventilation have been associated with extubation failure, although their predictive value is low.[9] Upper-airway obstruction can occur due to edema, ulceration, or inflammation resulting in glottic or subglottic narrowing. The risk of upper-airway obstruction increases with the duration of mechanical ventilation,[5] and many neurologically impaired patients undergo prolonged intubation.

Inadequate secretion clearance also contributes to extubation failure. Effective clearance of respiratory secretions requires adequate laryngeal and expiratory muscle function and adequate cough. Additionally, swallowing dysfunction and consequent aspiration may occur in extubated patients. Increased airway secretions may also contribute to inability to adequately clear secretions. Patients with depressed mental status are at increased risk of laryngeal and swallowing dysfunction and may be unable to effectively participate in pulmonary hygiene. Clinicians have attempted to prospectively assess these causes of extubation failure to predict the likelihood of successful extubation in neurologically impaired patients. The results of these trials will be discussed in detail below.

Pro: Clinical Trials Supporting Delayed Extubation of Neurologically Impaired Patients

The American College of Chest Physicians/American Association for Respiratory Care/American College of Critical Care Medicine consensus guidelines on weaning from mechanical ventilation recommend that "removal of the artificial airway from a patient who has successfully been discontinued from ventilatory support should be based on assessments of airway patency and the ability of the patient to protect the airway."[2]

It is generally agreed that depressed mental status is a risk factor for inability to protect the airway, although the safe extubation of comatose patients has been reported.[4] Given that discrepancy, one must question the strength of the correlation between depressed neurologic status and extubation failure.

Mokhlesi and colleagues prospectively followed a cohort of 122 patients on mechanical ventilation for at least 2 days, in an effort to identify predictors of extubation failure.[10] Sixteen of the 122 patients required re-intubation within 48 hours. After multivariate analysis, Glasgow coma score (GCS) < 10 was found to be an independent predictor of extubation failure, with an adjusted odds ratio of 13. Namen et al performed a randomized controlled trial that compared a respiratory-therapist-driven weaning protocol to standard practice in a neurosurgical ICU.[11] Multivariate analysis showed that GCS was strongly associated with extubation success ($P < .001$), independent of the method of weaning. A GCS ≥ 8 was associated with successful extubation in 75% of cases, while only 33% were successful when GCS was < 8 (Fig. 1).

Salam and colleagues assessed the ability of 88 patients who had successfully completed an SBT to perform 4 simple tasks (open eyes, follow with eyes, grasp hand, and stick out tongue) prior to extubation.[12] Patients unable to complete the 4 commands were 4 times more likely to require re-intubation (risk ratio 4.3, 95% CI 1.8–10.4). Depressed cough peak flow (risk ratio 4.8, 95% CI 1.4–16.2) and secretions greater than 2.5 mL/h (risk ratio 3.0, 95% CI 1.0–8.8) were also independent predictors of extubation failure (Table 1). All 3 risk factors interacted synergistically, implying an inability to control the airway and secretions in patients with depressed mental status.

In a prospective cohort specifically assessing brain-injured patients, Coplin and colleagues prospectively followed the course of mechanical ventilation, weaning, and extubation in 136 intubated patients.[4] Ninety-nine patients (73%) were extubated on meeting readiness criteria, and the remaining 37 patients (27%) remained intubated for a median of 3 days (range 2–19 d) longer than required by the weaning criteria. Patients with prolonged intubation had a lower median GCS (7 vs 10, $P < .001$). GCS was not found to be predictive of the need for re-intubation.

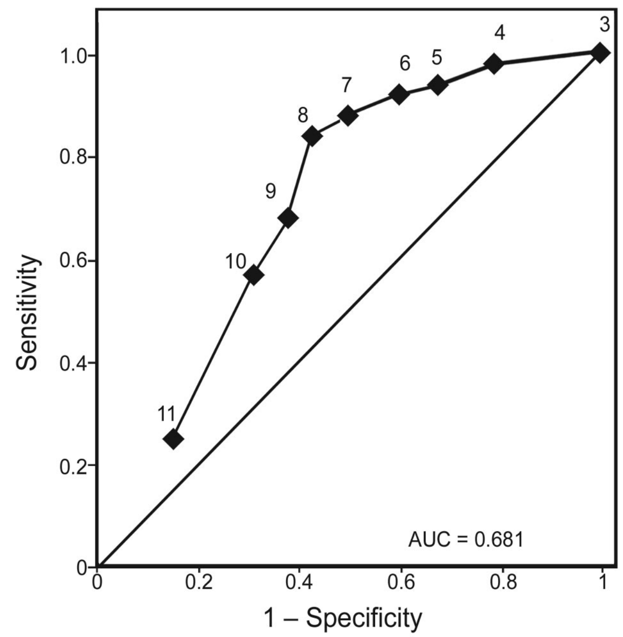

Fig. 1. Receiver operating characteristic curve of Glasgow coma score for predicting successful extubation in neurosurgical patients. A Glasgow coma score ≥ 8 was associated with best prediction of successful extubation in neurosurgical patients, with an area under the curve (AUC) of 0.681. (From Reference 11, with permission.)

This study is often cited as supporting the safety of extubating patients with acute brain injury, but caution should be used in interpreting these data. Given that the prolonged-intubation group was delayed in their time to extubation, the natural history of this group was altered and may not reflect the outcome that would have been obtained if they had been extubated at the time indicated by the weaning criteria.

Given the above studies, it seems that impaired neurologic status is probably a predictor of extubation failure. Given the absence of randomized controlled trial data supporting the safety of extubating brain-injured patients unable to follow commands, we would caution providers against doing so until further data are obtained. Manno and colleagues published a paper assessing the feasibility of performing such a trial.[13] They concluded that a study including 64 to 110 patients in each arm would have an 80% power to detect a clinically important difference in extubation failure rate between the 2 groups. We look forward to such a trial so that this question can be laid to rest and the care of these complex patients is optimized.

Con: It is Safe to Extubate Patients Unable to Follow Commands?

As noted above, it has been well demonstrated that an abnormal mental status delays extubation and results in

Table 1. Characteristics of Variables for Predicting Extubation Outcome

Variable	Sensitivity (%)	Specificity (%)	Likelihood Ratio	Risk Ratio (95% CI)
Cough peak flow ≤ 60 L/min	76.9	65.7	2.2	4.8 (1.4–16.2)
Secretions ≥ 2.5 mL/h	71.4	62.0	1.9	3.0 (1.01–8.8)
Unable to perform all 4 tasks	42.8	90.5	4.5	4.3 (1.8–10.4)
Any two of the above risks*	71.4	81.1	3.8	6.7 (2.3–19.3)
Negative white-card test	71.4	51.4	1.5	2.3 (0.8–6.7)
RSBI > 100 breaths/min/L	14.3	93.2	2.1	1.9 (0.5–6.9)

* Any two of cough peak flow ≤ 60 L/min, secretions ≥ 2.5 mL/h, or unable to perform all 4 tasks.
RSBI = rapid shallow breathing index (respiratory rate divided by tidal volume)
(Data from Reference 12.)

more prolonged mechanical ventilation.[4,10,14-16] In a prospective observational study, 355 patients were screened daily for weaning readiness.[14] When deemed ready (daily screening passed), patients who received an immediate SBT had a higher GCS than those whose SBT was delayed by a day or more (GCS 13 vs 9). The delayed-SBT group had longer mechanical ventilation and ICU stay. In the study of Namen et al, a successful SBT was followed by extubation only 25% of the time.[11] The primary reason for not extubating a patient who passed an SBT was level of consciousness (84%). In the Awakening and Breathing Controlled trial, patients in the intervention arm were both more alert and more likely to be extubated on the day they passed an SBT.[15]

As noted earlier, there are studies showing that inability to follow commands (or the like) is associated with extubation failure. But many of these studies were flawed, and there are as many studies showing no relationship between mental status and extubation outcome. About the studies that showed increased risk of extubation failure, one must ask 2 questions. First, how great is the increased risk? How often did the studies control for other factors known to increase the risk of extubation failure? Second, and most importantly, is not whether the patient tolerates or fails extubation, but what are the outcomes of those events?

In a study of 242 medical ICU patients, Kollef et al noted that those receiving continuous intravenous sedation were more likely to fail extubation than those receiving no or intermittent bolus dosed sedation (14/93 [15%] vs 7/149 [5%], $P = .005$).[17] But the sensitivity of continuous intravenous sedation was 0.67, and the specificity was 0.64, yielding a positive likelihood ratio of 1.86. The positive likelihood ratio is the ratio of the probability that a patient failing extubation will have an abnormal mental status, divided by the probability that a successfully extubated patient will have an abnormal mental status. A likelihood ratio value > 1 indicates a greater probability of extubation failure; a value of 1–2 indicates minimal difference in probability of failure; a value of 2–5 indicates a small probability difference; a value of 5–10 indicates a moderate probability difference; and a value > 10 indicates a large probability difference. Therefore, the presence or absence of continuous intravenous sedation was associated with only a minimal difference in the probability of failed or successful extubation.

Pronovost and colleagues conducted a prospective cohort study of a pre-extubation worksheet with surgical ICU patients thought ready for extubation.[18] Fourteen (14.5%) of 186 patients required re-intubation. Patients judged by the ICU nurse to be agitated, confused, or sedated were more likely to need re-intubation (5/24 [21%] vs 9/162 [6%], sensitivity 0.36, specificity 0.89, positive likelihood ratio 3.3). Suctioning requirement of more than every 4 hours was associated with failed extubation. No multivariate analysis was performed to assess the independent effect of abnormal mental status.

In a study to test the reliability and validity of the Richmond Agitation-Sedation score, Ely et al found a trend toward a lower median Richmond Agitation-Sedation score (−3 vs −2, $P = .07$) among patients who failed extubation.[19] These results must be viewed with caution; only 137 of 275 patients were included, and in these the Richmond Agitation-Sedation score used was measured during the shift prior to extubation, *not* at the time of extubation.

Two studies published in abstract form found delirium to be a risk factor for extubation failure. Coller and coworkers found that delirium, assessed with the Confusion-Assessment Method for the ICU, within 48 hours after extubation was associated with a trend toward re-intubation (16% vs 8%, $P = .07$).[20] Miller et al found those with delirium had 3 times the risk of extubation failure, compared to those without delirium.[21] In contrast, Lin et al found that delirium within the first 5 days of ICU stay was not associated with extubation failure (19.4% vs 19.6%).[22]

Three studies of unplanned extubation have found abnormal mental status to be associated with the need for re-intubation. Betbesé et al found that 21 of 52 patients with Ramsay scores of 1–3 required re-intubation, compared to 6 of 7 patients with Ramsay scores of 4–6,[23] but the effect of abnormal status cannot be accurately determined because all 6 re-intubations occurred in patients yet to start weaning and after accidental unplanned extubation, which are established risk factors for re-intubation after unplanned extubation. Chevron and colleagues found a lower GCS (10 vs 14) in those re-intubated, but, as in the study by Betbesé et al, Chevron et al did not control for whether unplanned extubation occurred after the patient had already initiated weaning trials.[24] Listello and Sessler observed that "mental status other than alert" predicted need for re-intubation, but the positive likelihood ratio was < 2, and they did not control for whether unplanned extubation was deliberate or accidental, and patients with abnormal mental status were much less likely to have anticipated planned extubation soon (22% vs 59%).[25]

Vidotto and colleagues prospectively studied 92 patients who required at least 6 hours of mechanical ventilation after craniotomy.[26] All the patients had a GCS ≥ 8 and were extubated after passing a 30–120-min SBT; 15 (16%) required re-intubation. Re-intubation was needed in 10 (12%) of 83 patients with GCS of 10–11, and in 5 (56%) of 9 patients with GCS of 8–9, yielding a sensitivity of 0.33, a specificity 0.95, and a positive likelihood ratio of 6.6. Vidotto et al did not control for the adequacy of cough and volume of secretions.

Finally, Namen et al studied 100 extubated neurosurgical patients, noting that 39% failed.[11] Patients with GCS < 8 were more likely to fail than those with a score ≥ 8 (25% vs 63%, sensitivity 0.55, specificity 0.81, positive likelihood ratio 2.9). Interpretation of this study is difficult because failure was defined as need for re-intubation or death any time after extubation, and without exclusion for do-not-resuscitate patients. Namen et al controlled for whether patients could cough spontaneously or with suctioning, but did not assess the burden of airway secretions. Lastly, it is not clear whether all patients passed an SBT before extubation.

Taken together, these studies indicate that, in univariate analysis, an abnormal mental status (assessed using various criteria and definitions) is associated with failed extubation. In several of these studies the extubation failure rate with abnormal mental status is within a range acceptable to most clinicians. None of these studies adequately controlled for cough and secretions, 2 factors important in assessing the ability to protect the airway.[12,27,28] This raises the question of whether abnormal mental status alone is responsible for extubation failure. Or, rather, is it the combination of an abnormal mental status and poor cough and excess respiratory secretions that leads to re-intubation?

In contrast to the studies above, a number of investigators have *not* found abnormal status to be associated with increased risk of extubation failure. The study by Coplin et al found similar extubation failure rates in patients with a GCS < 8 and GCS ≥ 8 (20% vs 16%).[4] Notably, Coplin et al found that 10 of 11 patients with GCS ≤ 4 were successfully extubated. In a retrospective study of 62 neurologic ICU patients with various diagnoses (17.5% required re-intubation), Ko et al found no difference in the Full Outline of UnResponsiveness (FOUR) score (which combines assessment of eyes, brainstem, reflexes, and respiration) between those who failed and those who succeeded extubation.[29]

In a prospective study of 900 extubated patients, Frutos-Vivar et al noted that 121 (13.4%) required re-intubation within 48 hours of extubation.[9] In a comprehensive analysis, they noted 3 risk factors for extubation failure: pneumonia as the cause of respiratory failure; positive fluid balance in the 24 hours before extubation; and an elevated ratio of respiratory frequency to tidal volume. They assessed mental status immediately prior to extubation as the patient's "ability to cooperate," subjectively defined as excellent, moderate, or poor. Patients who failed extubation were no more likely to have a poor ability to cooperate than those successfully extubated (39% vs 32%).

Beuret and co-workers prospectively followed 130 patients, ventilated for a minimum of 24 hours (mean 8 d).[30] The primary goal was to demonstrate that patients who failed extubation had reduced cough strength, defined as a lower peak cough expiratory flow. They also assessed mental status and found that patients unable to follow commands were not at increased risk of extubation failure (3 [12%] of 24 patients vs 11 [10%] of 106 patients). The earlier-mentioned pilot study by Manno and colleagues randomized 16 patients with severe brain injury to different extubation strategies.[13] Both groups had to pass a 30-min SBT and have a low Airway Care score (which combines assessment of cough; of suctioning frequency; and of sputum quantity, character, and viscosity). The early group was extubated independent of GCS (mean GCS 7), whereas the delayed group had to have GCS > 8 (mean GCS 9) for at least 12 hours. There was no difference in need for re-intubation.

This latter study and those mentioned earlier reinforce the importance of controlling for cough and secretions when considering the effect of abnormal mental status on extubation outcome. This issue has been directly examined in 3 studies. The study by Salam et al found that cough peak flow ≤ 60 L/min, secretions ≥ 2.5 mL/h, and inability to complete 4 tasks (stick out tongue, open eyes, follow with eyes, and grasp hand) were all independently associated with risk of extubation failure.[12] But it was only when 2, and especially 3, of these risk factors were present that risk increased to a rate of possible clinical importance (Fig. 2). Indeed, in the absence of excessive secretions and poor cough, an abnormal mental status alone was not a strong predictor of extubation outcome.

In the study by Mokhlesi et al, a GCS ≤ 10 was associated with significantly increased risk of extubation failure (50% vs 9% with GCS > 10), but pre-extubation

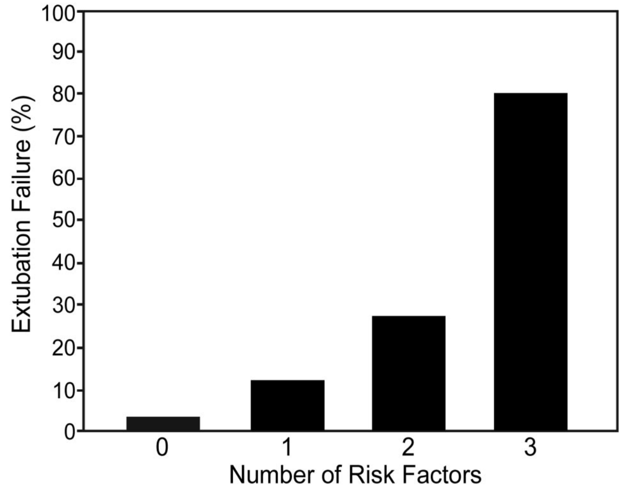

Fig. 2. Relationship between number of risk factors (cough peak flow ≤ 60 L/min, secretions ≥ 2.5 mL/h, inability to complete 4 tasks) and extubation failure rate. (Data from Reference 12.)

$P_{aCO_2} \geq 44$ mm Hg and need for airway suctioning more than every 2 hours were also identified as independent risk factors.[10] In a further analysis, Mokhlesi et al showed that it was only when hypercapnia was present that a low GCS was associated with significantly increased risk of re-intubation (Fig. 3).

This concept was recently tested in a randomized controlled trial with 318 patients with neurologic or neurosurgical diagnoses, by Navalesi and co-workers.[31] Patients in the intervention arm were screened daily and given an SBT if, in addition to adequate hemodynamics and gas exchange, the GCS was > 8, cough was clearly audible on suctioning, and suctioning was needed less often than every 2 hours. With this approach the intervention arm was less likely to need re-intubation than the control patients, who received usual care (5% vs 12%, $P < .05$).

Summary

When looking at univariate analyses, the reported studies are relatively evenly divided among those that did and did not find that inability to follow commands (ie, abnormal mental status) increases the risk of extubation failure. When risk has been found to be increased, it is often not prohibitive. Or, if markedly elevated, there has been failure to control for 2 other vital factors in determining extubation outcome: the adequacy of cough, and the volume of respiratory secretions. Multivariate analyses that have controlled for those 2 factors found abnormal mental status to be an independent predictor but not necessarily one of sufficient magnitude to preclude extubation. In addition, although extubation failure is a risk factor for poor overall outcome in heterogeneous populations, its impact on the patient failing with neurologic dysfunction has not been adequately determined. Nevertheless, the many studies showing poor outcome in patients who fail extubation cannot be ignored, so further investigation is warranted. One limiting factor in all the reported studies is how "inability to follow commands" is defined. The majority of studies use the GCS, but this is difficult to determine in the intubated patient. Moreover, using the cutoff of GCS ≥ 8, favored by many authors, is questionable, as some patients with higher GCS may be unable to follow commands. A prospective randomized trial using a more specific definition of "following commands" would certainly help remove some of the uncertainty in this patient population.

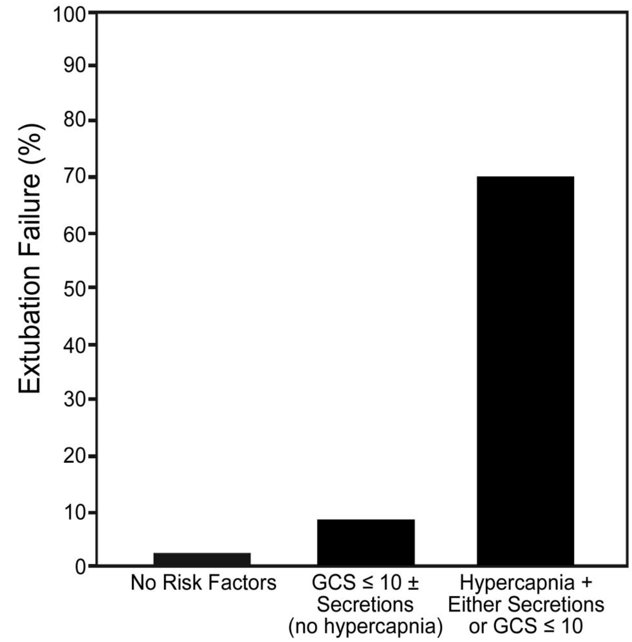

Fig. 3. Relationship between risk factors and extubation failure rate. Hypercapnia was defined as $P_{aCO_2} > 44$ mm Hg measured at the end of a spontaneous breathing trial. GCS = Glasgow coma score. (Data from Reference 10.)

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Discussion

MacIntyre: The Glasgow Coma Score (GCS) of 8 gets tossed around a lot here, and there are several ways of calculating GCS. Isn't it calculated differently for intubated patients? A regular GCS of 8 is pretty well out of it, but if you modify it for intubation, a score of 8 is not quite so bad. I want to make sure we've got this straight.

Epstein: You can have a Glasgow of 8 and not be following commands. In studies that calculate the GCS in intubated patients, they will typically calculate the best motor response and eye opening, and then they'll give a verbal response score of one. You can have a score of 8 and not be following commands. For example, you can get 5 for your motor response, 2 for eye opening, and 1 for best verbal response, and you've got an 8 even if you're not following commands. You might even have a 9 and not be able to follow commands, and I think that's a problem.

Moores: I don't think the GCS is what we should focus on. The ability to follow commands says a lot more. The test of following 4 simple commands may be a better measure, because GCS doesn't necessarily get at what you want it to. Some of the studies that have looked at extubation have done several things. Some did it the way you're suggesting, with a modified GCS (such as an 8T or a 9T), but others specifically addressed it by saying that if the patient could write a note in response to the nurse or could mouth words around the tube, then they got the full verbal response score. Some modify it, some don't.

MacIntyre: But you were both using cutoffs of 8 and 10, and variations of those, and I just wanted to clarify that we're talking about patients who might not be able to follow commands, even with scores of 8 or 10.

Moores: Right.

Epstein: Absolutely. We're using surrogate markers, and we must bear in mind the limitations of the GCS for this kind of analysis.

MacIntyre: I think the data are pretty compelling that you do not have to be able to follow commands to be successfully extubated.

Moores: Yes, I was concerned when I saw my topic assignment for this presentation, because I don't necessarily believe in the pro position, but I wanted to really look at the data.

Regarding Scott's point that we don't have any data that re-intubation in this group is necessarily a bad thing, I think he's correct that most of the available data on the morbidity and mortality associated with re-intubation is from a very mixed group of patients. In Scott's 1998 study he commented that the patients who failed because of airway issues and failed early don't seem to have any change in their outcome, but the ones who failed later (and we called it airway, but it was really encephalopathy) appeared to have worse outcomes. However, the numbers were so small, so I wonder whether we aren't getting at airway versus mental status, and, if they're re-intubated purely for mental status, is that bad?

Epstein: Only 7 patients got re-intubated for encephalopathy in that study, so it's hard to draw any definitive conclusions. And others have found the same thing. If you get re-intubated for an airway problem, you tend to do well. Most of those people tend to get re-intubated more rapidly, although at least in our study, there were still independent factors.

Talmor: Lisa, at Walter Reed [Army Medical Center] you must deal with many patients like this. What's your experience there?

Moores: Yes, we see many patients with traumatic brain injury, so arguing the pro side was difficult for me. We don't use mental status or GCS as an independent predictor or in a checklist. We tend to evaluate how cooperative the patient is and whether they can follow commands. But even with that, we do exactly as Scott has suggested. We're more interested in secretions and cough. What kind of gag do they have? How much secretions? How frequently are we suctioning? Anecdotally, our brain-injury patients who have failed extubation failed because we underestimated secretions. A lot of those end up going on to tracheostomy just to manage secretions, and that's really the issue. The ones who don't have that problem we seem to extubate just fine.

MacIntyre: To the respiratory therapists here I'd like to ask this. I round with you guys, and often it's the respiratory therapist who will come to me and say, "Mr Smith or Ms Jones looks pretty out of it to me and doesn't follow commands; I think we ought to leave the tube in another day." Dean, can you comment on that?

Hess: Sure, I'll start and the others can join in. I don't round with you, Neil, but I round with others where this issue comes up. This is an anecdote that I often use, and it's certainly the lowest level of evidence. I remember from early in my career the case of Karen Ann Quinlan. She had anoxic brain injury and her parents went all the way to the Supreme Court to get permission to have her extubated so she could die. She was extubated and lived 10 more years. I use that anecdote many times to make the point that you don't have to be awake and following commands in order to get extubated.

Gentile: It depends on the patient population too. The various ICU populations are quite different, of course. Is it some sedative the patient is metabolizing, or can they protect their airway? The airway failures are the ones that scare everybody the most. We ask the patient, "squeeze my hand, stick your tongue out, lift your head off the bed," and the new one I saw somebody ask last week was, "can you shrug your shoulders?" We used to have 3, and now I guess we have 4 cooperation tasks. The concern is always whether we'll to have to re-intubate right away. Some people are, because of experience, a lot more hesitant, and others are more gung-ho.

MacIntyre: The other issue that clinically happens all the time is that somebody is usually on sedatives, they can move around, they may not completely be following commands, but the decision is, "let's not extubate until we can get more sedation off." I always get nervous if we take too much sedation or analgesia off before we've taken the tube out. That tube starts to irritate the throat and the patient can get agitated, and, as you guys pointed out, they are also a potential extubation risk. I'm concerned that we don't necessarily have to get the sedatives completely off before pulling the tube, and, in fact, a little bit of sedation to blunt the irritant effects of the endotracheal tube before it gets yanked might be useful.

Moores: I think our approach at Walter Reed has been to get them off sedation if we can. But if they get agitated as we lower the sedation, then we tend to use a 2-step approach. First, we try to get away with just a narcotic, hoping that it'll have less sedative effects. Then, if there's still a high degree of anxiety or other agitation, we'll try something like haloperidol, if there isn't a contraindication, but something that's not such a central-nervous-system or respiratory depressant. If that doesn't work, then we go back to approaching them like someone with a lower GCS and who isn't on sedation, and ask, can they otherwise protect their airway?

Sessler: I think that's how we look at it as well. In our place we're at a disadvantage because we have a high incidence of alcohol and drug abuse disorders, so there is a greater likelihood that those folks do not achieve a Richmond Agitation-Sedation Scale score of zero (ie, calm and alert), and you're forced to extubate with a little less certainty as to their mental status. There have been studies of dexmetatomadine as a drug with less suppression of respiratory drive during that peri-extubation period as an alternative to traditional drugs.

I agree with both of you that the combination of poor mental status and secretions tends, at least in the patients who I recall most clearly where they passed everything else, and—lo and behold—it's 48 to 72 hours and they retain secretions and don't do well. So the question then is, as you pointed out, if they have an abnormal mental status and not a secretion issue, can they protect the airway?

Are there any data on the incidence of aspiration following extubation in patients who don't have an airway-secretion issue but clearly have impaired mental status? To a certain extent, that's the group that you've focused on as being the patients where maybe there isn't evidence that the mental status is that important.

Moores: That was one of my questions too, and only a few of the papers looked directly at that. I don't know if there is any consistent way to monitor for aspiration. Most authors focus on the surrogate marker of pneumonia. In fact, the pneumonia rate seemed to be much higher when you left them on the ventilator than when you removed the tube, suggesting that you don't have more micro-aspiration in those patients, despite a low GCS.

Epstein: I don't think we have data. We have data on swallowing dysfunction in patients who've been extubated, showing a very high prevalence, but I don't think in this particular patient population we have good data.

Regarding when and whether you stop sedation, this is what I find so interesting about the ABC [Awakening and Breathing Controlled] trial,[1] in which patients were randomized to either SBT alone or a spontaneous awakening plus an SBT. The patients in the spontaneous-awakening-plus-SBT arm did better because, when they passed the SBT, they were extubated sooner. There was no benefit in getting you to the point where you could pass an SBT, and that has made me think that having some sedation on board is not a bad idea during weaning. But as soon as they tolerate an SBT, that's a great time to turn off the sedation and get the tube out. It's a flip of the ABC study. I'd like to see that specifically studied.

1. Girard TD, Kress JP, Fuchs BD, Thomason JW, Schweickert WD, Pun BT, et al. Efficacy and safety of a paired sedation and ventilator weaning protocol for mechanically ventilated patients in intensive care (Awakening and Breathing Controlled trial): a randomised controlled trial. Lancet 2008; 371(9607):126-134.

MacIntyre: The point is that turning the sedation off would certainly make sense, but waiting until the sedation is completely worn off and getting them as awake as possible, I think you may miss a window of opportunity in there.

Epstein: Agreed. We haven't really talked about the rate of improvement, but that's also a major issue. If the patient has poor mental status, but you are fairly sure it will improve in the next 24–48 hours, it's probably better to wait to extubate that person. But if I don't anticipate their mental status improving, I would extubate right away, because I don't want any additional days of risk on the ventilator. But I'd re-intubate rapidly at the first sign of failure, if they are to be re-intubated.

Gentile: I suspect that mental status and/or airway protection are the top reasons people who pass an SBT stay on the ventilator. We have a lot of people who have passed SBTs but we're waiting for them to wake up to extubate. I don't know of any data on this, but I'm sure if we pored through these studies we'd find those are the reasons.

MacIntyre: The key question is, how awake do they have to be? My take-home message from this is they don't have to be as awake as we used to think.

Branson: One of our fellows in the trauma ICU recently published a paper[1] about sedation vacations. For a patient with an external pelvic fixator and a broken femur, the sedation vacation is not pleasant. I like Scott's idea that we should see if the patient passes an SBT and then turn off the sedation and extubate. That seems like a really good idea.

1. Robinson BR, Mueller EW, Henson K, Branson RD, Barsoum S, Tsuei BJ. An analgesia-delirium-sedation protocol for critically ill trauma patients reduces ventilator days and hospital length of stay. J Trauma 2008;65(3):517-526.

Siobal: I agree that emergence agitation is a big problem. In some patients who pass the SBT while sedated, you just turn it off and extubate them at the same time, so they don't appear they're going to fail. In terms of mental status, if their GCS is low and they've got secretions but they have a good strong spontaneous cough, that might indicate that they'll be able to clear some of their own secretions without lots of intervention. I'd feel more comfortable extubating someone like that. I like the idea of measuring peak cough flow as part of the assessment.

Durbin: Cough is really important, but if they're not swallowing the secretions, they are probably at even more risk of aspiration and respiratory infection. Intubated patients who drool copious secretions make me very concerned about extubation, whether they're awake or not. Brainstem dysfunction or swallowing abnormalities put them at risk of aspirating oral secretions, even if they don't have tracheal or lung secretions at extubation. I don't know any way to quantify that, but to me it's one of the biggest clinical markers of extubation failure, and often requires a tracheostomy.

Hess: In patients with poor cough and secretions, perhaps we should be more aggressive in assisting their cough. For example, John Bach reported[1] that mechanical insufflation-exsufflation allowed patients with neuromuscular disease to be extubated sooner, because you can deal with the secretions with cough-assistance. Perhaps that's something we should consider further.

1. Bach JR, Saporito LR. Criteria for extubation and tracheostomy tube removal for patients with ventilatory failure: a different approach to weaning. Chest 1996;110(6): 1566-1571.

Siobal: I call that thing the lung vacuum, because it vacuums the lungs out. It does work; it propels secretions to the upper airways. A device that just got Food and Drug Administration approval is a cuirass that externally delivers negative and positive pressure to expand and compress the chest wall.