Decision to Extubate Brain-injured Patients

Limiting Uncertainty in Neurocritical Care

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WHATEVER the field of critical care medicine, timely decision to extubate, to both prevent complications associated with extubation failure and undue ventilatory support, remains challenging. Finding reliable clinical predictors of extubation success still appears as a holy grail.[1] In this issue of Anesthesiology, Asehnoune *et al.* explored such predictors in the specific population of brain-injured patients.[2]

In neurocritical illness, invasive mechanical ventilation is frequently clinically indicated to manage life-threatening brain injuries responsible for agitation, stupor, or coma.[3] Airway protection provided by tracheal intubation prevents aspiration pneumonia and hypoxemia. Mechanical ventilation enables sedation and carbon dioxide modulation.

After improvement of acute neurologic failure, sedation withdrawal, and weaning from the ventilator, extubation readiness has to be evaluated.[1] Although pressure support liberation in this population is usually quite simple because cardiac and pulmonary capacities are mostly maintained, extubation failure could be very frequent, with some reported rates as high as nearly 40%.[4–6] Indeed, many factors associated with extubation tolerance could be altered by poor mentation, such as reduced respiratory drive, ability to cough and deal with secretions, and capacity to maintain respiratory tract patency and protect the airway. This could appear insignificant compared with specific brain interventions, but extubation failure *per se* exposes patients to complications such as nosocomial pneumonia, prolongation of intensive care unit (ICU) stay, and even mortality. Data regarding decision to extubate brain-injured patients are relatively scarce and heterogeneous with a majority of retrospective studies particularly exposed to biases notably associated with the ingrained supposition that restored consciousness is mandatory. In a landmark study, Coplin *et al.*[7] found that altered mental status by itself was not a limit to extubation provided that upper-airway protection reflexes and cough were maintained, introducing a paradigm shift.[7] Furthermore, delayed extubation only due to neurologic impairment was associated with nosocomial pneumonia, increased costs, and mortality. Others did not achieve these findings and uncertainty endures, leading to important practice variations.[8]

"Finding reliable clinical predictors of extubation success [in brain-injured patients] still appears as a holy grail."

The study by Asehnoune *et al.*,[2] published in this issue of Anesthesiology, affords new insights into factors associated with extubation failure of brain-injured patients. They conducted a multicentric, prospective, observational assessment of clinical criteria in a cohort of 437 brain-injured patients in four ICUs of three French university hospitals. Included adult participants undergoing scheduled or unplanned extubation were consecutively selected according to their initial Glasgow coma score ([GCS] less than or equal to 12 [median = 7; range, 5 to 10]), the type of brain injury (mainly traumatic brain injury and aneurysmal subarachnoid hemorrhage), and the duration of previous mechanical ventilation (more than 48 h). After acute neurointensive care management and stabilization, patients were checked as eligible for weaning if the GCS motor component was above or equal to 4 without continuous sedation and adequate regular hemodynamic, temperature, and respiratory parameters. After a successful spontaneous breathing trial and just before extubation, the attending physician evaluated a standardized physical examination checklist, based on *a priori* defined 26 semiquantitative clinical items. Extubation failure occurred in 22.6% within 48 h. The authors identified, in the multivariate logistic regression model, four features associated with success on the day of extubation: age less than 40 yr, visual pursuit, swallowing attempts (either spontaneous or on demand), and GCS greater than 10. In the constructed

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visual pursuit, swallowing, age, Glasgow for extubation (VISAGE) score, each item counted as one, related to similar odds ratios. A score of 3 or greater was associated with a high probability (90%) of extubation success. Validity was tested into the original cohort by means of a statistical surrogate called bootstrap, aimed at modelizing numerous alternative cohorts by random replacement of patients. The final area under the receiver–operator curve was 0.73 (95% CI, 0.68 to 0.79). As expected, extubation failure prolonged the duration of mechanical ventilation and ICU stay and was associated with increased mortality.

The authors have to be congratulated for providing prospective multicentric data on a large cohort in this specific field. Results confirmed cross-implication of the protective reflexes and neurologic status of airways. Age is also a known factor associated with extubation failure in general ICU patients.[9] Simplicity of a pragmatic clinical score that could be used at the bedside on a daily basis is fundamental, and the VISAGE score adheres to these criteria. For example, deglutition evaluation with endoscopy could appear as a gold standard but is difficult in intubated patients, needs dedicated material and skills, and lacks evidence-based, clear-cut thresholds.[9] VISAGE score could help rationalize the extubation process and give pertinent information to ICU care providers.

It has to be mentioned that GCS at time of extubation was quite high despite being statistically different between groups (median [25th to 75th percentiles] = 11 [10 to 14] *vs.* 11 [9 to 13]). Maximum motor score was 6 in both groups, corresponding with conscious patients. Moreover, patients were only eligible for weaning if the motor component of the GCS was 4 or greater and GCS of 8 or less was assimilated as an spontaneous breathing trial failure. Consequently, many patients had primary tracheostomy before any extubation attempt. Thus, the study by Asehnoune *et al.*[2] did not explore the entire neurocritical care population because patients with persistent severe consciousness alteration were excluded. It is usually a confounding factor in this field because studies frequently excluded comatose patients.[5,11]

The subgroup with profound consciousness alteration is, however, of particular interest because of important risk associated with the delay of extubation and undue tracheostomy.[7,12] Our group recently found in 140 brain-injured patients composed of comatose patients (median GCS at time of extubation = 9 [range, 8 to 10] *vs.* 9 [7 to 10]) that factors associated with extubation failure were neurologic status assessed by the Revised Coma Recovery Scale visual subscale (with capacity of visual tracking as a cutoff), ineffective cough, deglutition, and gag reflex.[6] As in the study by Coplin *et al.*,[7] some patients with profound alteration of consciousness could be safely extubated provided that they had restoration of upper airway protective reflexes. Moreover, extubation failure was determined at 48 h and 7 days.

The GCS, which was developed to standardize neurologic evaluation and triage of nonintubated brain-trauma patients in the 1970s, lacks sensitivity and specificity to detect subtle emergence of consciousness. Furthermore, the verbal subscale could not be evaluated in intubated patients, and possible aphasia is a major limit.[13] Visual tracking as a marker of neurologic progression to a minimally conscious state is easy to assess at the bedside.

Some study limitations should be mentioned. First, despite the statistical surrogate method, VISAGE score lacks sensitivity and external validation. Second, age is a nonmodifiable criteria and so we required a completion of all others factors to predict a high probability of extubation success. Third, patient selection and the definition of extubation failure appear confounding. Notably, primary tracheostomy performed before any extubation attempt represents a huge proportion of what is considered as an extubation failure (40%, meaning that 40 of the 99 reintubated patients were in fact tracheostomized patients), and final weaning remains challenging because alteration of laryngeal functions might persist and be further induced by tracheostomy cannula itself.

Finally, the work of Asehnoune *et al.*[2] largely implemented extensive observational data on extubation tolerance of brain-injured patients. The time has come to urgently shift to interventional studies to find the best management strategy because it contributes to the medical and societal burden of neurologic injuries.

Competing Interests

The authors are not supported by, nor maintain any financial interest in, any commercial activity that may be associated with the topic of this article.

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