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INVITED EDITORIAL COMMENTARY

Tracheostomy Practices in Neurocritical Care

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Historically, the outcomes of patients requiring mechanical ventilation for acute brain injury were poor, with a high percentage being reported dead or fully dependent at 6 months after admission [1]. These data led to a certain amount of therapeutic nihilism, and a tendency to early withdrawal of life support [2, 3] that neurocritical care as a field has worked hard to reverse [4]. Outcomes of mechanically ventilated patients with severe acute brain injury have improved [5], but a current review of tracheostomy practices nationally in patients with severe acute brain injury [6] suggests the possible evolution of two different treatment environments. Tracheostomy in patients with severe acute brain injury is a marker for treatment—it signifies an ongoing commitment to care and is not performed when there is the intention to discontinue supportive measures. Conversely, tracheostomy is often—but not always required in severely brain-injured patients until their airway protective reflexes, pharyngeal tone, and levels of activation and cognition have improved enough to at least clear secretions and maintain a patent upper airway [7, 8].

This analysis used the large National Inpatient Sample (NIS) administrative database to review tracheostomy epidemiology and practices among patients with diagnoses of stroke, traumatic brain injury (TBI), and hypoxic-ischemic encephalopathy (HIE) after cardiac arrest. The NIS includes 20% of non-federal hospitalizations, and this study reviewed 94,082 hospitalizations from 2002 to 2011 of patients admitted with a severe acute brain injury that underwent at least 96 h of mechanical ventilation. Thirty-two percent of these patients overall received tracheostomy, a number that rose from 28 to 32.1% during the study period and from 34.5 to 42.1% in the youngest cohort. Of the patients with severe acute brain injuries, most tracheostomies were performed for stroke (14,167) followed by TBI (11,587), and HIE (4701)—considered another way; however, 46.8% of the patients with severe TBI underwent tracheostomy versus 33% with stroke and 18% with HIE.

The most striking finding in multivariable modeling is that although undergoing tracheostomy was associated with younger age, male gender, and nonwhite race, it was also strongly and independently associated with larger (OR 1.34 [1.18–1.53]), urban (OR 1.6 [1.33–1.92]), and teaching (OR 1.15 [1.06–1.25]) hospitals. Looking at the raw data, a patient presenting with a severe acute brain injury to a small hospital had a 23% chance of receiving tracheostomy compared to 33% in a large hospital. Patients presenting to rural hospitals had 21% chance of tracheostomy versus 33% at urban centers. Nonteaching centers trached 33%, while teaching centers trached 36%. These increased likelihoods of tracheostomy at large, urban, and teaching institutions mean that the characteristics of the hospital were as important as the diagnosis, patient's age, or their medical comorbidities in terms of likelihood of receiving tracheostomy.

Do these findings suggest two different standards of care have evolved for severe acute brain injury in our hospitals—in which patients admitted to large urban centers get a prolonged "chance" at recovery, while those in smaller rural centers are directed toward palliation? Or do they simply show that patients whose families desire aggressive care tend to transfer them to the large urban teaching hospitals, or that patients in those centers are sicker and more often require tracheostomy? Unfortunately, the NIS does not contain adequate data to assess or compare the severity of illness among these patients, and we must read between the lines for meaning.

I was taught, early in my training as a pulmonologist, that a tracheostomy meant failure to wean: the patient's failure, but also mine. You were supposed to extubate

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everyone, and tracheostomy was an inelegant solution favored by intensivists who lacked finesse and the will to wean a ventilator [9]. Later, during training as a neurointensivist, I found the barrier to extubation in severe acute brain injury was infrequently cardiopulmonary readiness, and for many patients, a tracheostomy was in fact a pathway to early liberation from mechanical ventilation. At New York Presbyterian, we showed that when neurointensivists do their own trachs, delays to tracheostomy and ventilator weaning disappeared, sedation was reduced, and the intensive care unit (ICU) length of stay and cost of care fell accordingly. Tracheostomy was a very good way to get people out of the ICU, and off to acute inpatient rehab or a skilled nursing facility. [10] Most of the time, brain-injured patients with tracheostomy are awake and breathing—they quickly get off the ventilator, participate in rehab activities, and begin to interact with their families. These potential benefits drove the Stroke related Early Tracheostomy vs, Prolonged Orotracheal Intubation in Neurocritical care Trial (SETPOINT) pilot study of early versus delayed tracheostomy in acute stroke in Heidelberg, which demonstrated lower mortality with early tracheostomy [11].

One certainty is the important role of tracheostomy in the neuro-ICU. The point prevalence cross-sectional, prospective observational non interventional study in neurocritical care study showed tracheostomy to be the second most common procedure performed in neuro-ICUs, involving 20.5% of 1545 patients overall [12], and the current study suggests that over 10,000 tracheostomies were performed annually in the USA for severe acute brain injury between 2002 and 2011. When SETPOINT2 [13] is completed later this or early next year, we'll have high-quality data to help determine the best timing for tracheostomy after severe stroke, and information on how the timing of tracheostomy affects the patient and family experience. It may be that an airway is just an airway, or we may find that tracheostomy initiates a series of salutary events: getting off sedation, wakening, participating in rehab activities, and interacting with loved ones, that far outweigh the anticipated physiological benefits of the procedure.

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David B. Seder is co-Principle Investigator of the SETPOINT2 Trial of early vs. delayed tracheostomy in severe stroke with respiratory failure (NCT02377167).

Ethical Approval/Informed Consent
This article does not contain any studies with human participants or animals performed by any of the authors.

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