A Tale of Silent Aspiration: Are Guidelines Good for Every Patient?

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To many practicing physicians, clinical care guidelines often seem formulated based on the political, corporate, and economic opinions/agendas. Although outcome-based data are common, "expert opinions" continue to play major roles in guideline formulation, and ties between experts and industry are common. One consequence of guideline-based care is that specific patient needs may play second fiddle to these "best practices."[1,2] However, such practices can often be fleeting, and clinically accepted care "standards" are frequently reversed.[3,4] Prominent examples from the anesthesia literature include perioperative β-blockade and tight glucose control.

I recently observed closely (with nearly every waking minute for 2 weeks) how guideline-recommended "best care" was almost lethal to my wife. With 33 years experience as an anesthesiologist and a patient advocate, I made concrete suggestions to the care team regarding the well-known problem of silent aspiration (i.e., ventilator-associated pneumonia [VAP]).[5] My suggestions fell outside local protocols and were ignored, even though it was well known that I had previously been on staff at this hospital for 10 years. My personal and detailed observation of my most loved one's care led to a close consideration of the factors leading to VAP, including underlying mechanisms and opportunities for prevention. My wife provided consent for this publication, urging me to present her case history and these considerations to the medical community.

CASE REPORT

My otherwise very healthy 59-year-old wife has a short jaw and long neck, which has been associated with difficult airway management during a previous surgery. She was recently injured in a motor vehicle accident resulting in an unstable C5 vertebral body "burst" and C2 "hangman" fracture with significant incomplete quadriparesis below C4 (American Spinal Injury Association C). She was intubated with a 7.0-internal diameter endotracheal tube (ETT) without incident (or aspiration) using a fiberoptic approach in an outlying hospital and helicoptered to a level 1 trauma hospital. Surgical stabilization of the C5 lesion occurred 18 hours after impact and at a time when pulmonary function was unimpaired. During her acute hospitalization, I was present at the bedside for 12 to 16 hours each day.

Postoperatively, a C5 dural tear required prolonged, 70° head-up positioning to prevent cerebrospinal fluid leakage. The surgical need for repeated neurological status checks meant that my wife remained fully conscious throughout, excepting sedation for bronchoscopies. On the first postoperative day, limited degree of right-sided aspiration pneumonia was noted on chest roentgenogram, which, over the next 3 days, spread to both sides and became increasingly prominent. I noted that modern "guideline"-based "VAP bundles" involving chlorhexidine mouthwash and toothpaste were performed each shift and were associated with coughing and aspiration identified during subsequent endotracheal suctioning. Extubation or ETT exchange for a tube with an integral subglottic suction port was clearly contraindicated by the unstable C2 lesion (electively treated with neck collar restraint), significant neuromuscular compromise below C4, and worsening respiratory compromise. To reduce this aspiration burden, I encouraged the treating team to consider reducing intracuff pressures to allow an air leak at peak inspiratory pressure to clear pooled secretions from the subglottic trachea above the ETT cuff, but to no avail. Although the care team planned a tracheostomy for my wife, it was delayed for 9 days to protect the C5 surgical incision from cross-infection from tracheostomy secretions.

Unfortunately, during the next several days, my wife clearly developed aspiration pneumonia. After 4 days of this VAP bundle, her F_{IO_2} reached 100% with positive end-expiratory pressure = 10 cm H_2O, and oxygenation remained tenuous until the tracheostomy was performed. The tracheostomy site now drained copious, thick mucus secretions from above the cuff, which flowed out onto the dressing site for 2 to 3 days posttracheostomy. My wife's lung function slowly improved after tracheostomy placement, and glottis closure/competency recovered. She was weaned from the ventilator and her tracheostomy, first by cuff deflation, then by use of a speaking valve, then exchange for a smaller uncuffed tracheostomy tube, and finally complete removal after 25 days in the rehabilitation unit. Eliminating cuff inflation to allow spontaneous coughing around the tracheostomy tube, paralleled improved lung function and reduced aspiration. Clearly, humidified gas expelled around the cuff during spontaneous coughing proved effective against aspiration, effectively mobilizing and clearing secretions that had pooled in the subglottic area.

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DISCUSSION

During my wife's care, close personal observation by an experienced physician identified an obvious consequence of routine VAP care: pooled subglottic secretions and ongoing aspiration around the ETT cuff. In this case, VAP was really a misnomer for "ETT-associated" silent aspiration of pooled oral and subglottic tracheal secretions. Silent aspiration was actually accentuated by the extreme 70° upright positioning, facilitating movement of secretions around the ETT cuff and into the lower trachea.[6] Although the cuff–mucosa interface prevented airflow, it also enabled gravity-dependent fluid flow, like water leaking through the cracks in the walls of so many Pittsburgh basements. The ETT clearly impaired vocal cord competency, facilitating this leak. My suggestion to adjust cuff pressure to allow a small peak inspiratory pressure air leak with every breath (in effect using positive pressure ventilation as an expulsive medium) was rejected by the intensive care unit (ICU) staff, who instead adhered preferentially to their VAP protocol. The ventilator delivered pressure-controlled ventilation: positive end-expiratory pressure = 10 cm H_2O, F_{IO_2} = 1.0, and peak pressures of 31 cm H_2O at the time. Thus, pressure-controlled ventilation could allow an air leak while maintaining tidal volumes. Even though I was a physician and my Certified Registered Nurse Anesthetist wife supported these informed therapeutic suggestions, guidelines supervened over a logical, safe, and (vide infra) proven method of pulmonary protection. We would need to await tracheostomy placement days later as the definitive solution to this problem.

Even though expired humidified air, generated during a cough, is the usual way to clear the mammalian airways of secretions, this approach, easily adapted to the pressure-controlled ventilation, was dismissed along with an opportunity to prevent ongoing aspiration. Oddly enough, after tracheostomy and during my wife's recovery, the tracheostomy cuff was deflated, exchanged for a noncuffed tracheostomy, and finally removed, demonstrating that coughing around a tracheal cuff can be effective in clearing secretions! Passage of humidified air through the vocal cords could readily have been delivered by an ICU ventilator. More importantly, such air movement can easily expel pooled secretions from the 1- to 4-mm subglottic fissure into the hypopharynx, where they could "bubble from the mouth" and be suctioned. Patients with small cuff leaks can further increase expulsive volumes with coughing attempts. Either continuous or intermittent expulsive methods could have prevented my wife from "silently" aspirating secretions generated by oral hygiene treatments, rather than inadequately treating it after the fact with subglottic suction ETTs (SSETTs) and endotracheal suction.[7] Continual humidified air insufflation at physiologic pressures, via the port at the upper cuff edge of a SSETT itself, may produce sufficient expulsive airflow at the vocal cords to prevent secretion entry. Connecting the port of such SSETTs to the ventilator circuit may provide sufficient egress of humidified air from the vocal cords with each breath, especially if a sump were also placed in the pharynx to remove secretions.

As a clinical anesthesiologist practicing for over 3 decades, I safely use expulsive positive pressure routinely at every extubation.[8] It is common to see and suction these secretions originating from the supracuff-subglottic space. I was taught this method decades ago as a novice, and yet, it was rejected by the ICU staff.[8] I have personally further developed and have used for over a decade, a method of applying topical "laryngeo-tracheal anesthetic" onto the trachea and vocal cords by injecting lidocaine down the ETT and allowing a similar expulsive gas delivery technique to "spray" the lidocaine onto the trachea and vocal cords. This method, described elsewhere,[9,10] effectively mitigates laryngospasm and detrimental reflexes at tracheal extubation. Actively allowing gas escape at peak pressure moves supracuff-subglottic space–accumulated fluids upward and away from the intubated and incompetent glottic opening (Table 1). This method of aspiration prophylaxis would require only a change of practice and no additional equipment. Uncuffed tubes have been used for decades in children, and a "leak at 20 cm" is standard. Because modern ventilators measure expired gas volumes and readily compensate for small cuff leak, adjusting cuff pressures to leak slightly at peak inspiration would be relatively risk free.

Only when researching and writing this article did it occur to me that the use of chlorhexidine and toothpaste–VAP bundle therapeutic agents—can be expected to pool in the subglottic area and produce adverse toxic effects on reaching the lung parenchyma. I was astonished to find that in animal studies, chlorhexidine >0.1% concentrations exhibits significant pulmonary toxicity; however, toxicity has never been specifically addressed in intubated humans, where pulmonary aspiration is an expected risk.[11,12] Toothpaste may similarly be a pulmonary toxin. Toothpaste typically contains abrasive silicates, aluminum oxides, and other particulate substances difficult to metabolize in situ. It would seem most appropriate to use only clear saline solutions for oral hygiene in intubated patients or at the very least demonstrated safe and soluble antiseptics. In light of the known toxicity of aspirated chlorhexidine and highly probable toxicity of aspirated toothpaste, the oral use of chlorhexidine or toothpaste seems contraindicated.

Given the history, availability and clear logic of using air to clear secretions from the glottis opening, common

Table 1. "Coughing the Cuff" Before Tracheal Suction Using "Recruitment Breaths"

Increase F_{IO_2} to 1.0
Adjust (as appropriate and tolerated) PEEP upward to 10 cm H_2O and apply maximal tidal volume breath via self-inflating manual bag insufflation (Ambu resuscitator)
At onset of positive pressure, rapidly deflate ETT cuff
Immediately before the end of positive pressure, reinflate ETT cuff with removed gas volume
Immediately suction trachea via ETT lumen as usual and then pharynx
Return to ventilator settings at previous baseline settings

ETT = endotracheal tube; PEEP = positive end-expiratory pressure.

sense might suggest its use when aspiration is clearly occurring, as it was with my wife. However, in this case, guideline-based care prevented the application of this very straightforward strategy. Because these contrary guidelines prevailed, it seems we must rediscover historic precedent through research against the "current standard." Unfortunately, even though the impact on aspiration pneumonia may be considerable, the study of such generic measures without promise of potential corporate profits often holds little interest.[13] Would routinely allowing the air leak cause problems to occur in excess of benefit? Not in my experience. Conversely, toothpaste and chlorhexidine are included in the VAP bundle, apparently without clear understanding or even concern for aspiration mechanisms and toxicity. With 2 studies currently reporting clear chlorhexidine pulmonary toxicity, it is time to reconsider![11,12]

In the recent scandal involving chlorhexidine and the National Quality Forum's guidelines for sterile skin prep, the US Justice Department settled a $40 million whistleblower lawsuit alleging that CareFusion (San Diego, CA), the maker of ChloraPrep®, had inappropriately influenced the National Quality Forum.[a] Events such as these suggest that there are clear conflicts of interest in guideline creation. Thus, guidelines should not impair scientific thought and advancement, or the application of reasonable, commonsense, or logical measures. They should certainly not supersede reasonable patient parameters, or patient needs and wishes! Should we ignore humidified air as a means for reducing aspiration in intubated patients? Is it time to "cough the cuff" and routinely clear secretions? I believe that there is a role for this strategy and hope that someone will investigate further. We will never know when we or our loved ones might benefit. ■

[a]Allen M. Hidden Financial Ties Rattle Top Health Quality Group. ProPublica, January 28, 2014. Available at: http://www.propublica.org/article/hidden-financial-ties-rattle-top-health-quality-group. Accessed January 18, 2015.

DISCLOSURES

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