

## References

1. Lundström LH, Møller AM, Rosenstock C, Astrup G, Wetterslev J: High body mass index is a weak predictor for difficult and failed tracheal intubation: A cohort study of 91,332 consecutive patients scheduled for direct laryngoscopy registered in the Danish Anesthesia Database. *ANESTHESIOLOGY* 2009; 110:266–74

2. Bagust A, Walley T: An alternative to body mass index for standardizing body weight and stature. *Q JM* 2000; 93:589–96
3. Lebedowska MK, Alter KE, Stanhope SJ: Human Body Shape Index based on an experimentally derived model of human growth. *J Pediatr* 2008; 152:45–9

(Accepted for publication June 23, 2009.)

Anesthesiology 2009; 111:921

Copyright © 2009, the American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins, Inc.

*In Reply:*—We will like to thank Woehlk *et al.* for their interesting and relevant comments on our assessment of the association between body mass index and a difficult tracheal intubation (DTI).<sup>1</sup> We consider the ponderal index (PI) as an operational measurement for obesity, which may be usable in a clinical context as a possible bedside test for predicting a DTI. We performed a preliminary multivariate regression analysis to determine if it is possible to include both body mass index and PI in the same model. This analysis left PI as the only independent significant risk factor for DTI, suggesting that PI may be a better predictor of DTI than body mass index. Nevertheless, the association between PI and DTI was only marginal stronger than between body mass index and DTI. We report this preliminary result with certain reservations, as it may depend heavily on the stratification of the PI,<sup>2,3</sup> which is by no means straightforward, as the cutoff value is not naturally given. Furthermore, our preliminary analysis suggests only marginal benefits as to the prognostic accuracy, with PI dichotomized at 25. To determine if a more clinically relevant and statistically significant relationship between the PI and DTI exists, more comprehensive

and profound analyses with relevant model control are necessary. Therefore, based on our cohort, we may be able to present a more thorough assessment of this topic in the future.

**Lars Hyldborg Lundstrøm, M.D.,\* Ann M. Møller, M.D., Dr.Sci., Jørn Wetterslev, M.D., Ph.D.** \*Herlev Hospital, Copenhagen University, Herlev, Denmark. lars\_hyldborg@hotmail.com

## References

1. Lundstrøm LH, Møller AM, Rosenstock C, Astrup G, Wetterslev J: High body mass index is a weak predictor for difficult and failed tracheal intubation: A cohort study of 91,332 consecutive patients scheduled for direct laryngoscopy registered in the Danish Anesthesia Database. *ANESTHESIOLOGY* 2009; 110:266–74
2. Altman DG, Royston P: The cost of dichotomising continuous variables. *BMJ* 2006; 332:1080
3. Royston P, Altman DG, Sauerbrei W: Dichotomizing continuous predictors in multiple regression: A bad idea. *Stat Med* 2006; 25:127–41

(Accepted for publication June 23, 2009.)

Anesthesiology 2009; 111:921–2

Copyright © 2009, the American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins, Inc.

## Ventilator-associated Pneumonia or Endotracheal Tube-associated Pneumonia or None of the Above? Lessons Learned from Laboratory Animal Studies

*To the Editor:*—We wish to address the now almost universally accepted notion, well summarized in a recent manuscript “Ventilator-associated Pneumonia or Endotracheal Tube-associated Pneumonia: An Approach to the Pathogenesis and Preventive Strategies Emphasizing the Importance of the Endotracheal Tube” by Pneumatikos *et al.*<sup>1</sup>

The authors emphasize that “The accumulation of contaminated secretions from oropharynx or gastrointestinal tract in the subglottic space is a crucial event in the pathogenesis of VAP [ventilator-associated pneumonia].” Hence, the authors’ center of attention is directed to the pooled secretions around the cuff; they believe that “an important preventive strategy should focus on blocking up the leakage of subglottic secretions around the cuff (between ETT [endotracheal tube] and tracheal mucosa), drainage of secretions from subglottic space, and decontamination of the subglottic secretions;” while patient position has no impact on the incidence of ventilator-associated pneumonia, as it is not even mentioned, or alluded to.

Indeed, we have shown it is the patient position that is the *sine qua non* factor that determines the probability (yes, even certainty) of whether bacteria colonized oropharyngeal (or subglottic) contents and tracheal/lung secretions, will gravitate towards the oropharynx, and back into the lungs, with important consequences for the patient (analogous to the waste-water tubing in the sewer line). The authors are kind to cite our study in sheep, using the Mucus Shaver and Mucus Slurper which, when combined with keeping the orientation of the trachea below horizontal, prevented accumulation of secretions within the lumen of the endotracheal tube, the trachea, and the lungs, without need for conventional tracheal suction. Left unsaid, our subsequent studies showed that tilting/

keeping the trachea (and sheep) below horizontal alone resulted in equally good outcome: No pneumonia, and no lung bacterial colonization.<sup>2,3</sup>

It is the latter observation that has consumed, over many years, most of our subsequent attention. Insufflating small tantalum discs into the trachea of sheep, beyond the tip of the endotracheal tube, has allowed us to monitor transport of so insufflated tantalum discs across and beyond the tip of the endotracheal tube and observe its travel during the course of mechanical ventilation. The results were as follows: With the sheep’s body/head oriented in the semirecumbent position, mucus-tracheal contents rather rapidly gravitate towards the lungs, then enter the mainstem bronchi, and lodge at the most distal end of the bronchi.<sup>4</sup>

However, with the head/neck oriented horizontally/below horizontal (about 5–15 degrees), all mucus and secretions, together with the insufflated tantalum discs, exited the bronchi and the trachea, then entered the endotracheal tube, and then exited into the expiratory line water trap and not into the lungs.

In a recent prospective controlled trial, 80 intubated infants were randomized to supine position ( $n = 30$ ) or to lateral position ( $n = 30$ ) to keep the orientation of the neck/trachea at or below horizontal.<sup>5</sup> After 5 days of mechanical ventilation, tracheal cultures were positive in 26 infants (87%) in the supine position group and in 9 infants (30%) in the lateral group ( $P < 0.05$ ). In the adult patient population, similar results have been observed (unpublished observations, Lorenzo Berra, M.D., Department of Anesthesia and Critical Care, Massachusetts General Hospital, Boston, Massachusetts, June 2009), showing feasibility of such patient management and excellent clinical outcome.

In summary, while medical devices (Mucus Shaver, Mucus Slurper, antiseptic impregnated endotracheal tubes, Hi-Lo Evac endotracheal