■ CORRESPONDENCE

Paradigm Consciousness: A New Approach to Understanding Anesthesia Knowledge and Education

To the Editor:—Kudos to Waisel *et al.* for his recent contribution to our journal, "Anesthesiology Trainees Face Ethical, Practical and Relational Challenges in Obtaining Informed Consent."[1] And also to our editors, for highlighting the usefulness of nonbiomedical research paradigms. Waisel *et al.* used narrative analysis, one genre of qualitative research methods, to deepen our understanding of the theory that underlies obtain informed consent in the practice of anesthesiology. Narrative analysis is only one of many accepted methodologies included in the realm of qualitative research. Others include biographical methods, critical theory development, hermeneutics, action research, and historiography. Qualitative methods, in any form, are both similar and different from our more familiar, quantitative, statistically based methods.

In both quantitative and qualitative methods there is an initially defined research question; optimal data sampling is based on known population characteristics; data collection and analysis follows rigorously defined protocols; and all sampling, data collection, analysis, and dissemination are in compliance with accepted research ethics.[2]

However, unlike hypothesis testing and statistical methods, qualitative research employs an inductive approach; the aim of qualitative research is to generate a theory grounded in both confirming and disconfirming evidence, such as observation, interviews, and documentation. These methods for theory generation are more useful in situations of complex social interactions where reductionist, statistical methods cannot adequately encapsulate all social confounds into one testable hypothetical premise, to the exclusion of all others. Qualitative research methods have been a mainstay of social science and educational and psychological research for close to a century. And within the past two decades, they have been successfully merged with quantitative methods, especially in educational research, to both generate and confirm theory.[2,3] This innovative methodology is termed "mixed methods research."[4]

For those more interested in understanding and using complimentary qualitative methods, several outstanding and readily accessible reference texts are available.[2] In addition, both PubMed and the Education Resources Information Center have medical subject headings that allow the reader to identify literature that employs qualitative methods. Hopefully the paradigm wars are indeed over, and the era of paradigm cooperation has begun in anesthesiology as well.

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The above letter was sent to the authors of the referenced report. The authors did not feel that a response was required. —James C. Eisenach, M.D., Editor-in-Chief.

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Body Mass Index: An Illogical Correlate of Obesity

To the Editor:—Lundstrøm *et al.*[1] demonstrated that high body mass index (BMI), defined as weight per height squared (kg/m^2), is a weak but significant predictor of difficult tracheal intubation. Exact determination of body composition to define the quantity and distribution of muscle and fat requires complex measurements unavailable in the perioperative setting. Teleologically, one hopes that an easily derived parameter like BMI can quantify obesity, which one intuitively expects to correlate with difficult tracheal intubation. Although the World Health Organization has adopted BMI to quantify obesity, BMI remains a misunderstood empiric 19th-century observation that is an illogical parameter for this task.[2,3]

BMI compares weight (and approximate volume) to surface area, which correlates to useful physical characteristics such as joint loading (force/area) or heat retention (mass of metabolically active tissue per surface area available for heat loss). It may not be apparent that, for objects of identical shape and density, BMI is directly and exactly proportional to height. Using the definition above, one can easily calculate that a 1-cm cube of water has a BMI of 10, a 2-cm cube of water has a BMI of 20, a 1-m cube of water has a BMI of 1,000, and so forth. However, differences in height may overwhelm differences in thickness: Short overweight patients may have a lower BMI than tall thin patients. The ponderal index ($PI = kg/m^3$) is a statistic proportional to the cube of the height instead of the square of the height. Because volume and mass are cubic functions of the linear dimension, the PI depends on shape but is insensitive to height: The PI of a sphere of water is always 523.6, the PI of a cube of water is always 1,000, and normal human PI is within a narrow range of 10 to 14.[3] The PI is more commonly used in pediatrics when height changes rapidly; during adolescence, the PI may decrease as children become taller and proportionally thinner, even though the BMI may paradoxically increase.[3] The human body shape index (HBSI) seeks to determine the optimal exponent, which appears to lie between 2.7 and 2.9 over a wide range of heights and ages ($HBSI = kg/m^{2.8}$).[3]

For these reasons, Lundstrøm *et al.* may find better correlations between either the PI or human body shape index and difficult tracheal intubation than between BMI and difficult tracheal intubation. The authors' data are a valuable resource, and we would like to encourage them to determine if a more significant relationship can be obtained using the PI or the human body shape index.

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In Reply:—We will like to thank Woehlck *et al.* for their interesting and relevant comments on our assessment of the association between body mass index and a difficult tracheal intubation (DTI).[1] 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,[2,3] 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.

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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.*[1]

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.[2,3]

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.[4]

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.[5] 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