

tubes [Tyco Healthcare UK Ltd., Gosport, United Kingdom], prototype endotracheal tube cuff, and so forth) may represent an improvement in the care of the intubated and mechanically ventilated patient, we believe that the sole factor that can avoid pneumonia in our intubated patients is keeping the orientation of the endotracheal tube below horizontal to drain outward oropharyngeal bacteria-colonized secretions that travel according to the laws of gravity.

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# Endotracheal Tube-associated Pneumonia

*To the Editor:*—We would like to congratulate Pneumatikos *et al.* on the review article on ventilator-associated pneumonia (VAP).<sup>1</sup> An increased understanding of the pathogenesis and prevention of VAP has resulted in the proposal for a ventilator bundle with particular emphasis on semirecumbency, early awakening, and liberation from mechanical ventilation.

The most common cause of VAP is clearly upper aerodigestive tract colonization, followed by pulmonary aspiration past the cuff of the endotracheal tube (ETT) or tracheostomy tube. After this, the inner lumen of the ETT develops a biofilm and the circuit becomes contaminated.<sup>2</sup> Microaspiration and VAP are intimately linked, and this has led to a search for improvements in the design of the traditional ETTs and tracheostomy tubes. High-volume, low-pressure cuffed ETTs came into practice in the early 1970s after the high incidence of tracheal injury related to low-volume, high-pressure cuffed ETTs. Seegobin *et al.* showed that high-volume, low-pressure cuffed tubes were completely ineffective in preventing leakage of aspirates as compared with low-volume, high-pressure tubes<sup>3</sup>; however, the practice could not change because low-volume, high-pressure tubes do not have the ability to control the pressure transmitted across to the tracheal wall.

Unless we can completely prevent pulmonary aspiration during mechanical ventilation, we cannot hope to prevent VAP. An engineered solution to assist clinicians in the interruption of the VAP pathogenesis pathway and facilitate a ventilator bundle is required. In short, a new design of ETT is needed.

There is such an ETT, currently approved for clinical use in Europe, called the LoTrach™ tube and cuff pressure controller.<sup>4</sup> The main advantage of the LoTrach™ system is the unique cuff, which has been calibrated during the manufacturing process so that the low-volume cuff will transmit a desirable tracheal wall pressure of 20–30 cm H<sub>2</sub>O at all times. There are no folds in the cuff of the tube to allow fluid leakage, and so a 20–30 cm H<sub>2</sub>O column of fluid can be held above the cuff. The efficacy of cuff to tracheal seal when compared with that of standard high-volume, low-pressure cuffs has been shown in a pig model, in anesthetized patients, and in critically ill patients.<sup>5</sup>

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*In Reply:*—We thank Drs. Berra and Kolobow and Drs. Sathishkumar and Fassl for their interest in our review.<sup>1</sup>

Berra and Kolobow raise the interesting question about the role of the patient position in the development of ventilator-associated pneumonia

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The LoTrach™ tube also has triple subglottic ports through which intermittent suctioning of secretions can be performed. The integrity of the cuff to tracheal seal is sufficient so that it will permit decontamination by irrigation of the entire supracuff airway with large volumes of saline.<sup>4</sup> The tube is flexible and has an atraumatic tip suitable for long-term intubation, and it has an inner nonstick coating to reduce secretion accumulation over time. Initial clinical data look very encouraging,<sup>6</sup> and we believe that United States regulatory approval is currently awaited. VAP is the leading cause of nosocomial morbidity and mortality in intensive care units, and the costs of VAP are so high that substantial additional investment in prevention makes both financial and humanitarian sense.

The ideal ETT is a worthy aspiration. It should provide a complete clinical seal to isolate the lungs, continuous cuff pressure control, effective subglottic secretion drainage, and biofilm resistance, and it should be gentle on the airway structures.

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(VAP), and argue that keeping the orientation of the endotracheal tube below horizontal is the sole factor that can avoid VAP in intubated patients.

First, our review focuses on the pathogenesis and the preventive strategies of VAP, emphasizing the importance of endotracheal tube,