

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).¹ 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.² 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 tubes³; 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.⁴ 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 H₂O at all times. There are no folds in the cuff of the tube to allow fluid leakage, and so a 20-30 cm H₂O 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.⁵

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.⁴ 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,⁶ 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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In Reply:—We thank Drs. Berra and Kolobow and Drs. Sathishkumar and Fassl for their interest in our review.¹

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

(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,

hence we do not mentioned the role of patient positioning and its impact on VAP.¹ Second, we disagree with the opinion that the orientation of the endotracheal tube below horizontal will result in reduced incidence of VAP for the reason that it is based on insufficient clinical data: three experimental animal (sheep) studies,²⁻⁴ a randomized controlled trial with 60 ventilated infants that compared the tracheal colonization rate and not the VAP incidence in supine *versus* lateral position,⁵ and unpublished observations in adult patients.

The possible body positions for orientation of the endotracheal tube below horizontal are head-down (Trendelenburg) position and lateral head-down positions. In our opinion, these positions are uncomfortable, unsafe for patients with raised intracranial pressure, and inappropriate for patients in the weaning process. Furthermore, there is evidence that the semirecumbent position is the optimal body position for VAP prevention in critically ill patients.⁶

Drs. Sathishkumar and Fassl report the advantages of the LoTrach™ tube (Hi-Lo Evac; Mallinckrodt, Athlone, Ireland) and the cuff pressure controller regarding the prevention of pulmonary aspiration during mechanical ventilation. In fact, the LoTrach tube and the cuff pressure controller are designed to offer triple protection against pulmonary aspiration: The low-volume, low-pressure cuff without folds offering effective tracheal seal at permanent tracheal wall pressure between 20 and 30 cm H₂O; the triple subglottic ports for intermittent suctioning of secretions and retrograde cleansing of the entire upper airway by irrigation with normal saline; and the nonstick inner lumen designed for reduction of adhesion of biologic material and biofilm formation.

We believe that the LoTrach™ tube and the cuff pressure controller will contribute substantially to VAP prevention. However, there are still limited data about the clinical impact of the use of the LoTrach™ tube on the incidence of VAP, and further clinical research is required.⁷

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Wren, Boyle, and the Origins of Intravenous Injections and the Royal Society of London

To the Editor:—I read with great interest the note on *Anesthesiology* Reflections by Bause,¹ where he writes that in 1659 the future Sir Christopher Wren and Robert Boyle pioneered intravenous therapy, adding that by November 1660 both were meeting with 10 other scientists; gatherings that would lead to the formal chartering of the Royal Society of London for the Improvement of Natural Knowledge. I would like to comment briefly on the accuracy or precision of three aspects: The date of the pioneering intravenous injections; the credit for this invention, as the paragraph suggests coauthoring; and the origins of the Royal Society of London.

Most authors agree that the first experiments on intravenous injections took place sometime in 1656, in Boyle's quarters on High Street at Oxford, United Kingdom, and all agree in attributing to Wren the idea and execution.²⁻⁵ Indeed, while Boyle, Wilkins, and Wren were discussing the action of poisons, the latter made the claim that he could easily contrive a way to convey any liquid poison into the mass of blood. Boyle provided a large dog, and summoned Willis and Bathurst to assist, presumably because more hands were needed to hold down the animal. Wren would later describe this in a letter, probably addressed to William Petty in Ireland, where he states that "I Have Injected Wine and Ale in a living Dog into the Mass of Blood by a Veine, in good Quantities, till I have made him extremely drunk, but soon after he Pisseth it out." It is perhaps interesting to add that the dog survived, grew fat, and was later stolen from his owner. Boyle himself attributed authorship to Wren when he later commented on this and other ensuing experiments of the same kind.^{6,7}

As to the seminal meetings, some authors trace the Royal Society's origins back to 1645, to Gresham College in London, United Kingdom,

others to Wadham at Oxford somewhat later, while still others propose a more eclectic interpretation.⁸ These informal meetings, for which apparently no records were kept, were held regularly and with great enthusiasm. Remarkably, they united Royalists and Parliamentarians alike, despite the troubled times during the Civil Wars, the Commonwealth, the Protectorate, and the Restoration, when many of them lost or won their academic appointments, properties, and even liberty as a result of their allegiances. Surely, the main reason for this success is that recalled by John Wallis in 1678: "We barred all Discourses of Divinity, of State-Affairs, and the News (other than what concern'd our business of Philosophy confining ourselves to Philosophical Inquiries, and such as related unto; as Physick, Anatomy, Geometry, Astronomy, Navigation, Statics, Mecanicks, and Natural Experiments."⁹ The fact that many meetings were held or ended at a coffee house or pub must also have helped. Wren and Boyle, along with Wilkins, Willis, Wallis, Bathurst, and others, had been meeting regularly at Oxford for at least 5 yr before that gathering on November 28, 1660.

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