

Aerosols in Mechanical Ventilation: A Revolution in the Making

Thirty years ago it was common practice to administer aerosol therapy to mechanically ventilated patients, with precious little research to help guide our practice. When a ventilated patient failed to respond to a bronchodilator aerosol treatment, it was all too common to just increase the frequency of therapy, with the rationale that, compared to the price of a ventilator day, a few extra aerosol treatments couldn't hurt. The assumption was that the ventilator circuit and the endotracheal tube combined to form a "black hole" that would draw aerosol in but not allow it to reach the patient. Early studies confirmed that suspicion, and many clinicians became rather cynical and harbored low expectations for the therapeutic benefits of aerosol delivery to ventilated patients.¹⁻⁴

Whereas with a normal, spontaneously breathing subject we can expect 10% or more of a nebulizer dose to reach the lungs, we learned that only 1-3% would reach the lungs of an intubated, mechanically ventilated adult patient^{1,4} and less than 1% would reach the lungs of a ventilated infant.⁵ Since no respiratory drug designed for inhalation has been developed specifically for administration to ventilated patients, clinicians have been left to "guesstimate" comparable dosing for ventilated patients, with some advocating 5-50-fold increases above standard doses.⁶ Adapting nebulizers, which are typically designed for other applications, to the ventilator often resulted in substantial changes in ventilator parameters, as well as fouling the ventilator's expiratory valves and sensors, which are not designed to function in the presence of medical aerosols.

In the last decade we came to realize that the endotracheal tube might offer an advantage over the normal airway for delivering aerosol to the lung⁷ and that we might achieve greater aerosol delivery efficiency in intubated, mechanically ventilated patients than we achieve with our standard therapy in ambulatory patients. Early proof of this came with the discovery that the same metered-dose inhaler that delivers 10% of a dose to the lung of an ambulatory patient could deliver 11% to an intubated, ventilated patient.⁸⁻¹⁰ Soon thereafter researchers reported methods and techniques that achieve aerosol delivery ef-

iciencies of 30-80% in adult patients¹¹⁻¹⁵ and double-digit deposition in infants.

Only when we increase the efficiency and decrease the variability of aerosol delivery will the clinical world seriously consider the inhalation route a viable method for drug delivery to the critically ill patient. Systemic response times are faster with inhalation than with subcutaneous injection, so inhalation can be a more vital route for both pulmonary and systemic drugs. With drug development specifically oriented toward the ventilated patient, pulmonary drug delivery will be rivaled only by the intravenous route for speed, consistency, and efficiency.

It was my privilege to chair the symposium on Aerosol Delivery in Mechanical Ventilation at the International Respiratory Congress in Las Vegas, Nevada, on December 8, 2003. It was gratifying to have a 3-hour standing-room-only session, and the attendees enjoyed presentations from a dynamic and internationally renowned faculty. Each presenter has been a pioneer and visionary in his field, and we hope that this issue of *RESPIRATORY CARE* provides respiratory therapists a valuable resource to fine-tune their delivery of aerosols in the intensive care unit.

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