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Inhalation therapy in mechanical ventilation

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Devices that produce aerosol particles of < 2 μm in mass median aerodynamic diameter are more efficient during mechanical ventilation than are those that produce larger particles. Other factors influencing aerosol drug delivery to mechanically ventilated patients include the aerosol-generating device, the condition of the ventilator circuit, the artificial airway, and the ventilator settings. Next-generation nebulizers known as vibrating membrane nebulizers or vibrating mesh nebulizers have recently been developed, their aerosol delivery efficiency having been estimated to be twice to three times as high as that of jet nebulizers.

Ari et al.[1] conducted an experimental study comparing jet nebulizers and vibrating membrane nebulizers in terms of their efficacy in simulated pediatric and adult lung models during mechanical ventilation. The authors found that drug (albuterol sulfate) delivery was 2- to 4-fold greater with a vibrating mesh nebulizer than with a jet nebulizer ($p = 0.001$). It is of note that active humidification was used in that study.

Given the wide range of variables that can influence inhaled drug delivery to patients on mechanical ventilation, we read with great interest the review article by Maccari et al.[2] However, we found it surprising that the authors did not include vibrating membrane nebulizers among the nebulizers for use in mechanically ventilated patients. In addition, Figure 1 in the aforementioned study[2] shows a heat and moisture exchanger. The authors reported that the use of humidifying devices reduces aerosol deposition and the number of deposited particles by as much as 40%. An update of the American Association for Respiratory Care guidelines recommends that filtered heat and moisture exchangers be removed during nebulization.[3] This can be confusing and misleading to the reader.

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AUTHORS' REPLY

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We thank you for your interest in and criticisms of our review article.

Indeed, recent improvements in nebulizer treatment have led to the development of vibrating membrane nebulizers (also known as vibrating mesh nebulizers), which generate aerosol particles that are more suitable for lung deposition, as demonstrated in in vitro studies. Therefore, vibrating membrane nebulizers are more efficient than jet nebulizers and can deliver higher doses of aerosolized drugs to the distal airways.[1] However, given that there have been few clinical studies evaluating the use of this new technology in patients on mechanical ventilation, questions remain regarding the use of vibrating membrane nebulizers in clinical practice, including questions regarding the optimal dose of medication for use with vibrating membrane nebulizers. Other factors limiting the use of vibrating membrane nebulizers include their high cost and the difficulty in cleaning them.[2] In addition, vibrating membrane nebulizers are not widely used in Brazil. Given that the primary objective of our review article was to aid in daily clinical practice, we addressed issues related to inhalers that are available in most ICUs in Brazil.

Humidification is indeed associated with increased particle impaction in the ventilator circuit and can reduce aerosol deposition in the distal airways by as much as 40%.[2] However, the recommendation to remove the heat and moisture exchanger (shown in Figure 1 in our study) during nebulization is controversial, given that heating and humidification are aimed at preventing hypothermia, endotracheal tube obstruction, atelectasis, bronchospasm, and respiratory infection.[2]

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