Ventilation

Breathing (or ventilation) is the process of moving air into and out of the lungs to facilitate gas exchange with the internal environment, mostly by bringing in oxygen and flushing out carbon dioxide.

Mechanical ventilation, using artificial methods to assist breathing.

Volume-controlled ventilation has been suggested to optimize lung deposition during nebulization although promoting spontaneous ventilation is targeted to avoid ventilator-induced diaphragmatic dysfunction. Comparing topographic aerosol lung deposition during volume-controlled ventilation and spontaneous ventilation in pressure support has never been performed. The aim of this study was to compare lung deposition of a radiolabeled aerosol generated with a vibrating-mesh nebulizer during invasive mechanical ventilation, with two modes: pressure support ventilation and volume-controlled ventilation.

Seventeen postoperative neurosurgery patients without pulmonary disease were randomly ventilated in pressure support or volume-controlled ventilation. Diethylenetriaminepentaacetic acid labeled with technetium-99m (2 mCi/3 mL) was administrated using a vibrating-mesh nebulizer (Aerogen Solo(®), provided by Aerogen Ltd, Galway, Ireland) connected to the endotracheal tube. Pulmonary and extrapulmonary particles deposition was analyzed using planar scintigraphy.

Lung deposition was 10.5 ± 3.0 and 15.1 ± 5.0 % of the nominal dose during pressure support and volume-controlled ventilation, respectively ($p < 0.05$). Higher endotracheal tube and tracheal deposition was observed during pressure support ventilation (27.4 ± 6.6 vs. 20.7 ± 6.0 %, $p < 0.05$). A similar penetration index was observed for the right ($p = 0.210$) and the left lung ($p = 0.211$) with both ventilation modes. A high intersubject variability of lung deposition was observed with both modes regarding lung doses, aerosol penetration and distribution between the right and the left lung.

In the specific conditions of the study, volume-controlled ventilation was associated with higher lung deposition of nebulized particles as compared to pressure support ventilation. The clinical benefit of this effect warrants further studies. Clinical trial registration NCT01879488 [1)].

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Dugernier J, Reychler G, Wittebole X, Roeseler J, Depoortere V, Sottiaux T, Michotte JB, Vanbever R, Dugernier T, Goffette P, Docquier MA, Raftopoulos C, Hantson P, Jamar F, Laterre PF. Aerosol delivery with two ventilation modes during mechanical ventilation: a randomized study. Ann Intensive Care. 2016 Dec;6(1):73. Epub 2016 Jul 22. PubMed PMID: 27447788.