Letter to the Editor

Preventing mucus plugging in invasively ventilated intensive care unit patients—routine or personalized care and 'primum non nocere'

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We thank Dr. Rello for his comments on the results of the 'Preventive Nebulization of Mucolytic Agents and Bronchodilating Drugs in Intubated and Ventilated Intensive Care Unit Patients (NEBULAE)' study (1), a randomized clinical trial in invasively ventilated critically ill patients that compared routine with on-demand nebulization of acetylcysteine with salbutamol with respect to duration of ventilation (2).

Invasive ventilation increases the risk for sputum retention, since mucociliary clearance is impaired in the presence of the endotracheal tube and because relatively dry gases cause mucosa to produce more mucus. Routine airway care, consisting of repetitive endotracheal suctioning and humidification of inspired air, is thought to protect against mucus retention in the lower airways (3,4), though robust evidence for this is largely lacking. Routine nebulization of mucolytics was thought to have additive preventive effects against sputum retention in invasively ventilated patients. The NEBULAE study, however, taught us that routine nebulizations may not be so effective, as it does not translate in shorter time spend on a ventilator (2). We would like to echo the final line in Rello's comment that 'prevention is better than cure, but attempts at prevention must not entail other dangers'—this certainly applies for routine nebulization of mucolytics.

Ineffective coughing, resulting from depressed levels of consciousness, sedation and paralysis, together with weakness before and after extubation, is another reason why invasively ventilated patients are at increased risk for airway obstruction (5). Cough augmentation techniques, such as 'lung volume recruitment' or 'assisted cough', are suggested to prevent respiratory complications associated with chronic conditions like neuromuscular disease (6). With 'lung volume recruitment', also known as 'air stacking' or 'breath stacking', multiple successive insufflations result in a maximum long volume potentially improving the strength of a natural cough (7,8). With 'assisted cough techniques', like 'mechanical in-exsufflation' or 'cough assist' not only the tidal volume is increased, but also an inspiratory hold and a quick maximal release of air is performed, provoking an artificial cough. By creating expiratory flows higher than inspiratory flows, secretions may move cephalad (9,10).

By now, it is increasingly suggested that the above-described techniques may also benefit patients with acute respiratory failure who need invasive ventilation. Some even suggest that these techniques should be used routinely in these patients. One recently published meta-analysis focused on the question whether cough augmentation techniques have beneficial effects in invasively ventilated critically ill patients (11). An intensive search of the medical literature resulted in a meager number of three small investigations that studied these techniques. One trial reported a higher

extubation success rate in patients that received a strategy using mechanical in-exsufflation (12), and another trial a reduction in duration of mechanical ventilation duration with this intervention (13).There were, however, several severe adverse events including secretion encumbrance with severe hypoxaemia requiring reintubation. Other well imaginable risks like hypotension, due to the high intrathoracic pressures created with these techniques, and pneumothorax, caused by the large volumes of air in the lungs, were not reported, though maybe not collected sufficiently. These risks, for sure, are very likely to occur in critically ill patients, in whom they can also have severe consequences.

Indications for and contra-indications against cough augmentation techniques remain poorly defined. Lack of guidelines regarding indications and contra-indications, timing, machine settings, and technique to be used lead to varied use. Continuing research on this topic is eagerly awaited. Studies should not only investigate efficacy of these interventions, but also, or particularly feasibility and safety in this population of frail patients. While we think all these techniques have great potential in individual cases, we strongly argue against routine use as long as studies fail to provide robust evidence for efficacy, but certainly also for safety: 'primum non nocere'.

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Footnote

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References

1. Rello J, Domingo C. Precision medicine and aerosolization in mechanically ventilated adults. J Thorac Dis 2018 Sep;10:S3111-4.
2. van Meenen DM, van der Hoeven SM, Binnekade JM, et al. Effect of On-Demand vs Routine Nebulization of Acetylcysteine With Salbutamol on Ventilator-Free Days in Intensive Care Unit Patients Receiving Invasive Ventilation: A Randomized Clinical Trial. Jama 2018;319:993-1001.
3. Mwakanyanga ET, Masika GM, Tarimo EA. Intensive care nurses' knowledge and practice on endotracheal suctioning of the intubated patient: A quantitative cross-sectional observational study. PLoS One 2018;13:e0201743.
4. Restrepo RD, Walsh BK. Humidification during invasive and noninvasive mechanical ventilation: 2012. Respir Care 2012;57:782-8.
5. Konrad F, Schreiber T, Brecht-Kraus D, et al. Mucociliary transport in ICU patients. Chest 1994;105:237-41.
6. Auger C, Hernando V, Galmiche H. Use of Mechanical Insufflation-Exsufflation Devices for Airway Clearance in Subjects With Neuromuscular Disease. Respir Care 2017;62:236-45.
7. de Sá Feitosa LA, Barbosa PA, Pessoa MF, et al. Clinimetric properties of breath-stacking technique for assessment of inspiratory capacity. Physiotherapy Research International 2012;17:48-54.
8. Toussaint M, Pernet K, Steens M, et al. Cough Augmentation in Subjects With Duchenne Muscular Dystrophy: Comparison of Air Stacking via a Resuscitator Bag Versus Mechanical Ventilation. Respir Care 2016;61:61-7.
9. Kim CS, Iglesias AJ, Sackner MA. Mucus clearance by two-phase gas-liquid flow mechanism: asymmetric periodic flow model. Journal of Applied Physiology 1987;62:959-71.
10. Volpe MS, Naves JM, Ribeiro GG, et al. Effects of manual hyperinflation, clinical practice versus expert recommendation, on displacement of mucus simulant: A laboratory study. PLoS One 2018;13:e0191787.
11. Rose L, Adhikari NK, Leasa D, et al. Cough augmentation techniques for extubation or weaning critically ill patients from mechanical ventilation. Cochrane Database Syst Rev 2017;1:CD011833.
12. Gonçalves MR, Honrado T, Winck JC, et al. Effects of mechanical insufflation-exsufflation in preventing respiratory failure after extubation: a randomized controlled trial. Crit Care 2012;16:R48.
13. Crowe J, Rajczak J, Elms B. Safety and effectiveness of breath stacking in management of persons with acute atelectasis. Physiotherapy Canada 2006;58:306-14.

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