clearance technique over another, and this change occurred in our cohort when respiratory conditions became worse, which may indicate that CPAP could constitute a "bridge to bridge" in CF.

To our knowledge, very little is known about the time constant for a lung unit and lung mechanics in CF, especially if we have to tailor airway clearance interventions to the heterogeneous lung disease expressions in CF and then find appropriate outcomes. Only in the last decade have we learned about the positive effects of NIV,[21] and there is still so much to discover about the respiratory care of CF patients. To improve efficacy and adherence, we need further research on the effects of CPAP and NIV on mucus transport in CF. While the results from Aquino and colleagues are of questionable clinical importance, due to methodological bias and inaccurate surrogate end points, they suggest a possible advantage. Respiratory physiotherapy is on the verge of a potentially exciting era in CF, and we require a change in approach in step with the increasing complexity of the disease and the new technology available. Positive pressure, delivered via NIV or CPAP, might be a valid tool, especially in advanced lung disease,[18,21,22] and it would require more attention and smarter outcomes.

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The authors respond to: CPAP in Cystic Fibrosis: Is It Time to Surrender Yet?

The authors thank Gambazza and Zuffo for their interest in our paper evaluating hypertonic saline inhalation and CPAP, alone and in combination in subjects with cystic fibrosis (CF).[1] Gambazza and Zuffo are correct that there are few well controlled comparative studies of airway clearance techniques, in part due to the difficulty in masking and in meeting appropriate end points.[2] They are also correct in the observation that positive airway pressure, delivered either as positive expiratory pressure or CPAP, can maintain airway patency by moving the equal pressure point proximally in the airway: what they call airway "splinting." This would have little effect on mucus clearance, but, coupled with an effective cough, it would be expected to improve sputum clearance in the proximal airway generations.[3,4]

We evaluated the effects of CPAP, rather than positive expiratory pressure therapy, as the latter is more effort dependent. In these subjects with mild to moderate CF lung disease there was no benefit from CPAP therapy over the use of hypertonic saline alone.

We also measured the transport and surface biophysical properties of these secretions and found results consistent with previous publications.[5] It is not clear what these authors mean by "enhancing" mucus rheology. Regardless, hypertonic saline aerosol has no significant effect on the viscoelasticity of airway secretions, but rather serves to draw water into the airway, decreasing sputum tenacity (a surface property) and inducing an effective cough.[6] It is for this reason that our subjects were directed to produce 3 cough maneuvers.

The authors have referenced our publications detailing appropriate outcome measures for airway clearance interventions.[4,7] They note from our publications that sputum volume is not an appropriate outcome for evaluating the effects of chronic airway clearance therapy; however, we showed that sputum volume is an appropriate outcome for acute interventions, as we have reported here. Long term studies are difficult in this population, in part because of poor adherence to complex regimens.

We also appreciate the interesting observation from the Florence CF center that in persons with severe CF lung disease requiring supplemental oxygen and bi-level positive airway pressure ventilation at night there may be an additional and longitudinal benefit of adding CPAP to other therapies. We conducted an acute intervention study in subjects with relatively mild CF lung disease. Although the difference in our results may well be due to the rigors of a controlled trial, as compared with clinical observation, it is also probable that the effectiveness of an intervention is influenced by the severity of disease. Although persons with severe CF airway disease are more likely to have large airway malacia (marked by a flow transient on the flow-volume tracing) and distal migration of the equal pressure point, making CPAP more likely to be a useful adjunct in patients with severe CF lung disease, consistent with our study, the one published study of CPAP in this population showed no beneficial effect on pulmonary function, quality of life, or sputum expectoration.[8]

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