Negative Pressure Ventilation in Chronic Obstructive Pulmonary Disease: Another Brick in the Wall

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Although negative pressure ventilation (nPV) is an effective therapy for patients with restrictive lung disease [1] its position in the management of chronic ventilatory failure due to chronic obstructive pulmonary disease (COPD) is less clear. In the largest study to address this question Shapiro et al. [2] randomised 184 patients to receive either nPV or a sham treatment; no benefit was observed in any outcome measure including daytime PaCO_2 . Although this result confirmed some earlier reports [3, 4], other investigators had found (in much smaller studies) that a reduction in PaCO_2 was possible both during the application of nPV [5, 6] and during spontaneous respiration after a more prolonged period of therapy [5].

Thus one explanation for the findings of Shapiro et al. [2] could be that the patients failed to be adherent to nPV or that the ventilator was not able to sufficiently unload the respiratory muscle pump. In this issue of *Respiration* Kössler et al. [7] present data that goes some way to answer this question. Twenty-one patients with severe COPD (mean FEV_1 28% predicted) were studied. Each patient underwent 6 h of therapy for 5 days a weeks; 19 patients were able to accept nPV. For these patients unloading of the diaphragm was confirmed by surface electromyography at each nPV session. Despite achieving

an 80% reduction in the electrical activity of the diaphragm during respiration no significant change was observed in daytime PaCO_2 , 6-minute walk distance or respiratory muscle strength or endurance. Thus it seems unlikely that the lack of efficacy of nPV demonstrated by previous investigators [2–4] is simply due to insufficient rest of the respiratory muscles.

Kössler et al. [7] also concluded from these data that chronic fatigue had not been present in their patients since respiratory muscle unloading failed to result in an increase in inspiratory muscle strength as judged by the oesophageal or transdiaphragmatic pressure generated during a maximal voluntary sniff. As with the PaCO_2 previous investigators have found differing effects of nPV on inspiratory muscle strength, though previously this measurement has been made using the maximal static inspiratory mouth pressure. Respiratory muscle fatigue may be defined as a loss of tension (or pressure) generating capacity resulting from activity under load which is reversible by rest [8]. Two distinct physiological forms of fatigue are low and high frequency; in these conditions the loss of pressure generating capacity is specifically observed in response to stimuli of low (typically 10–20 Hz) and high (typically >50 Hz) frequencies, respectively. The form of fatigue which is long-lasting, and therefore most likely to

be of clinical relevance, is low frequency fatigue [9], but the inspiratory mouth pressure and sniff manoeuvres both involve short bursts of intense activity and are therefore regarded as high frequency manoeuvres. Therefore although Kössler et al. [7] may be correct to argue that fatigue does not play a role in the development of ventilatory failure in COPD this cannot be conclusively demonstrated from their study design. The most appropriate technique to address this question would be magnetic

phrenic nerve stimulation and this technique is known to be acceptable to patients with COPD [10, 11].

If the lack of benefit of nPV cannot be explained by technical problems this suggests that patients with COPD are difficult to ventilate which, in turn, suggests the need for carefully controlled studies to evaluate the place of non-invasive positive pressure ventilation in COPD. Therefore, it is reassuring that two large randomised controlled trials are in progress in France and Italy.

References

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