To recline is to relax? Not when you have COPD!

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Orthopnoea, the worsening of dyspnoea when supine, is due to more than just supine hyperinflation and altered lung mechanics, but also to increased respiratory drive https://bit.ly/34gGTtr

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Orthopnoea is the worsening of dyspnoea when adopting supine posture and occurs in people with heart failure, obesity, diaphragmatic paralysis and COPD. Orthopnoea in COPD without heart failure is likely a marker of more severe disease and, as such, may be recognised as clinically important by respiratory physicians. Despite the recognition of its importance, orthopnoea in COPD is understudied and therefore remains a poorly understood symptom in the clinical management of COPD.

In this issue of the *European Respiratory Journal*, Elbehairy *et al.* [1] explore neuromechanical decoupling as a potentially important pathophysiologic mechanism underlying orthopnoea in people with COPD. The authors measured changes in dyspnoea, mechanical properties of the respiratory system, and inspiratory neural drive upon adopting supine posture in people with COPD who reported orthopnoea and healthy age-matched controls. In the healthy group, supine posture reduced functional residual capacity (FRC), as expected, and dynamic compliance, but did not change breathlessness, work of breathing or inspiratory neural drive. That is, in supine posture, although the lungs were slightly stiffer under dynamic (breathing) conditions, it was not enough to demand increased effort to maintain ventilation. In contrast, supine posture did not alter FRC in participants with COPD, effectively increasing the level of hyperinflation when compared to the healthy group (supine hyperinflation). Despite this, supine posture still caused a reduction in dynamic compliance (the lungs were stiffer during normal breathing), likely due to an increase in airway narrowing and closure, and increased intrinsic positive end-expiratory pressure (iPEEP). The increase in stiffness was such that it resulted in greater work of breathing, hence greater inspiratory neural drive. The increase in dyspnoea in the supine posture correlated not only with the increase in inspiratory neural drive, but also with the poor or "disappointing" response in ventilation to that increase in drive (neuromechanical dissociation and neuro-ventilatory uncoupling). Therefore, orthopnoea is due to more than just supine hyperinflation and altered lung mechanics, but also to increased respiratory drive.

Elbehairy *et al.* [1] also reported an increase in expiratory flow limitation (EFL) in the supine posture for people with COPD that is consistent with published data [2–4]. Potential relationships between EFL and orthopnoea or supine mechanics were not reported, however. EFL occurs in severely narrowed airways such that flow cannot be increased, despite increasing alveolar driving pressure. Therefore, EFL is a clinically important measure of the severity of mechanical impairment in COPD and, as such, might

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potentially indicate greater likelihood of worsening mechanics lying down and, hence, orthopnoea. EFL has indeed been correlated with orthopnoea in COPD [2], albeit using a different measurement technique. It would be informative to know if supine posture-induced changes in EFL predicted changes in lung mechanics, *i.e.* dynamic compliance, neural drive and work of breathing.

These findings highlight that current pharmacological options are insufficient to relieve orthopnoea in people with COPD. Half of those studied by Elbehairy *et al.* [1] were taking standard, guideline-consistent, COPD therapy, *i.e.* long-acting β_2-agonist plus long-acting muscarinic agonist, with a third also on inhaled corticosteroids. From a pharmacological perspective, there are no additional options for these patients to reduce hyperinflation and protect against the deleterious effects of supine posture on lung mechanics. Since the reduction in dynamic compliance in supine posture likely involves airway narrowing and closure, and increased iPEEP (which has to be overcome by respiratory effort), continuous positive airway pressure (CPAP) might be useful in treating orthopnoea [5]. Indeed, one case report has detailed the benefits of CPAP on orthopnoea in a patient with morbid obesity and COPD [6]. Future research could aim to identify those patients with COPD and orthopnoea who may benefit symptomatically from CPAP, which would require rational titration of pressures to optimise mechanics.

Little is known about the clinical implications of orthopnoea and supine posture-induced changes in lung mechanics in COPD, such as for sleep quality, overall quality of life or exacerbation risk. People with COPD who have EFL when supine are more likely to have difficulty initiating sleep, nocturnal dyspnoea and nocturnal awakenings [4]. Importantly, the availability of commercial oscillometry devices provides the ability to measure lung mechanics seated and supine. Oscillometry is arguably the simplest and easiest way to identify EFL, in both upright and supine postures [7]. Oscillometry thus provides the opportunity to use supine posture as a way to "challenge" the lung. Furthermore, oscillometry can be applied during noninvasive ventilation in hypercapnic COPD patients, to accurately measure EFL [8] and, therefore, could be used to titrate CPAP to improve supine lung mechanics, abolish orthopnoea and potentially improve sleep quality and overall quality of life. CPAP is not considered as a potential treatment for COPD symptoms, other than those attributable to obstructive sleep apnoea. However, the impact of mechanical changes and sleep in COPD is very much under-appreciated and mostly unexplored in COPD, and the findings of Elbehairy *et al.* [1] provide a strong case to investigate the utility of CPAP.

COPD is a complex disease with varying characteristics that could influence symptoms, such as orthopnoea. Elbehairy *et al.* [1] studied only people with COPD who reported orthopnoea; consequently, it is not possible to determine the relative importance of increased neural drive and neuromechanical dissociation across a wider range of COPD phenotypes. Could body mass index, emphysema predominance, respiratory drive, daytime symptoms, diaphragmatic curvature, *etc*. modify symptomatic responses to those mechanisms?

Elbehairy *et al.* [1] have provided much needed mechanistic insight into orthopnoea in COPD. In particular, the finding that supine posture worsens respiratory system mechanics, causing a disproportionately high respiratory effort to maintain ventilation that predicts orthopnoea. These findings, and those that came before, ought to compel the research community to address the important but unappreciated problem of orthopnoea in COPD, which may also have implications for improving sleep quality for people with COPD.

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