Posture Perfect: The Role of Positioning During Bronchodilator Administration With Oxygen or Heliox

Over the years there has been great interest in treatment of patients with moderate to severe asthma presenting to the emergency department. To make a dent in these exacerbations, clinicians have modified label recommendations for short-acting bronchodilators with innovative delivery techniques, devices, doses, and frequencies of administration. Since 1935 the use of helium-oxygen mixtures (heliox) has been advocated in the treatment of severe airway obstruction.[1] While heliox improves deposition of aerosol particles in the lung, the clinical evidence on heliox is mixed.[2]

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The clinical effects of heliox-driven aerosol drug administration have been studied by a number of researchers over the years, with strikingly different findings. While some reported benefits from heliox,[3-8] others found no clinical benefits.[9-13] Upon analysis, it appears that the differences between these findings may be attributed to differences in research methods, patient characteristics, as well as aerosol and gas administration techniques. However, none of those studies considered the impact of the patient's posture during bronchodilator therapy. That changes with the report by Brandão and colleagues in this issue of RESPIRATORY CARE. They administered fenoterol (2.5 mg) and ipratropium bromide (0.25 mg) in 3 mL of normal saline with a small-volume nebulizer, at 20-min intervals, to asthma patients, with the torso leaning forward at 50–60° with the elbows resting on the thighs, or with the torso upright, with either oxygen or heliox as the nebulization gas. The forward-leaning posture with heliox gave the best FEV_1 improvement.[14] There was no difference between oxygen and heliox in the patients who were seated upright during bronchodilator therapy. In contrast, heliox plus forward-leaning posture produced the greatest percent-of-predicted FEV_1 improvement: $>$ 2 fold greater than heliox alone (103% vs 42%, $P = .03$).[14]

In previous studies of asthma, peak expiratory flow $<$ 40% of predicted has been associated with greater clinical response to heliox. Brandão et al note that asthma patients presenting to the emergency department during the study had less severe asthma (peak expiratory flow range 35–46% of predicted), which makes the greater response with the forward-leaning posture all the more remarkable.[14]

Clinicians have long noted the tendency for COPD patients with hyperinflated lungs to lean forward in an effort to reduce dyspnea. Nonetheless, many well-meaning therapists have encouraged asthma patients to sit up straight during therapy, or if in the hospital, to lean back in a semi-recumbent position. The implication of the report by Brandão et al is that such practice might be less than productive and possibly even detrimental. Since the forward-leaning posture was significantly superior to the upright sitting position, a specific review of positioning in adults with respiratory distress is warranted, to better understand why the forward-leaning posture enhances the effect of bronchodilators and heliox.

It is well known that patients with asthma and COPD can breathe easier in the forward-leaning posture, which may be due to the use of accessory inspiratory muscles, the effect of gravity on the abdominal muscles, and an effect on lung volume. For instance, while the activity of the accessory muscles affects the movement of the rib cage and assists inspiration in this posture, gravity pulls the abdominal wall down and increases the intra-abdominal pressure. Consequently, the functional residual capacity (FRC) is influenced by the pressure above and below the diaphragm.

According to previous literature, the volume-pressure curve shifts to the left, which creates negative intrathoracic pressure, moves the diaphragm down, and increases the FRC in the forward-leaning posture.[15,16] Therefore, the inspiratory muscles contract above FRC, as opposed to at the end of expiration to FRC,[16] and gravitational force due to the weight of the rib cage and shoulders acts as an expiratory force that optimizes expiration.[17] Since FRC and air-flow resistance are inversely related, an increase in FRC leads to a decrease in air-flow resistance, because airway caliber is a function of the cube root of lung volume.[18,19] No studies have investigated the effect of posture on the size of the airways in asthmatic patients, but one study reported that the anterior-posterior dimension of the oropharynx reduced from the upright to the supine position in both non-apneic snorers and patients with obstructive sleep apnea.[20]

Perhaps this forward-leaning posture increases FRC, improves air-flow resistance, limits air trapping, decreases the size of the airway, and changes the distribution pattern of inhaled aerosol. Whatever the reason, this effect definitely merits further investigation.

Posture is an important determinant of pulmonary mechanics, which has critical implications in patients with asthma and COPD. Brandão et al shed light on how pulmonary function is enhanced by the forward-leaning posture during heliox-driven or oxygen-driven aerosol therapy.[14] It seems fitting that physiotherapists would link posture with effectiveness of aerosol therapy. Perhaps this is a natural consequence of the perspective of their primary training. In most of the world, where respiratory therapy does not exist as a recognized profession, physiotherapists have long been the primary clinicians involved with innovation in asthma management and aerosol therapy. Brandão and colleagues have provided us a provocative insight into the role of posture in response to aerosol and heliox, which merits further consideration for the future of both research and clinical practice.

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