# A Fresh Look at the Physiologic Effects of High-Flow Nasal Cannulae and the Role They Play in Patient Care

Treatment strategies to address oxygenation problems in critically ill patients with hypoxemic respiratory failure commonly fall into 3 categories: use of simple oxygen equipment, use of noninvasive ventilation, or use of invasive ventilation. These categories typically represent a stepwise approach to the management of patients with increased levels of oxygen demands.

High-flow nasal cannula (HFNC), nasal high-flow oxygen therapy, and high-flow therapy are terms used to describe flows of $>$ 6 L/min delivered through nasal cannula. Most often these high flows are delivered through an air/oxygen blender and heated humidifier. What makes this therapy unique is that it not only provides oxygen therapy similar to other simple oxygen equipment, but it also provides a low level of CPAP. This CPAP effect was first noted by Locke et al in 1993,[1] and since has been well documented by a number of authors.[2-9]

The greatest fear clinicians have regarding high-flow therapy is the lack of knowledge of how much pressure is delivered to the airways. Although concern has been raised by some authors[6,7] regarding the CPAP pressure in premature infants, particularly those weighing $<$ 1,000 g, similar concerns have not been documented in the adult population. Current evidence has demonstrated that airway pressures do not exceed 4–5 cm $H_2O$ at flows as high as 40 L/min.[3,4,8,9] My colleagues and I, in an unpublished study of healthy adult volunteers using a HFNC system, also found that roughly 1 cm $H_2O$ of CPAP was associated with each 10 L/min increment in flow. The HFNC can then be considered a crossover strategy between basic oxygen equipment and noninvasive CPAP. In addition, it provides expanded capability while potentially maintaining some of the advantages of basic oxygen equipment. These potential advantages include increased patient adherence, increased patient comfort, and relatively low cost, compared to traditional noninvasive CPAP devices, and might free up ICU beds for patients requiring more invasive interventions.

Peters et al investigated the use of HFNC in patients with do-not-intubate status and publish their findings in this issue of RESPIRATORY CARE.[10] This was a small clinical study that enrolled 50 consecutive patients (25 men and 25 women) who met the inclusion criteria (do-not-intubate, dyspnea, tachypnea, hypoxemia, $P_{aCO_2} \leq 65$ mm Hg, and pH $\geq$ 7.28). All 50 patients were placed on HFNC; the treatment was successful in maintaining 82% (41) of these patients. The remaining 18% (9) of patients required escalation to noninvasive ventilation. The authors' findings suggest that HFNC may serve as a viable alternative to use of traditional noninvasive CPAP devices in this patient population.

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Logically, if a CPAP level is established using HFNC, there should be a corresponding increase in the functional residual capacity (FRC). This was verified in a study by Corley et al, published in the *British Journal of Anaesthesia* in 2011.[11] Also in this issue, Riera and colleagues further expand the growing body of evidence that supports an increase in FRC when using HFNC.[12] The authors used electrical impedance tomography to examine changes in lung volume (FRC) associated with the use of HFNC. They found that end-expiratory lung impedance increased with the use of HFNC, suggesting an increase in FRC. In patients with restrictive lung disease this has the potential to reduce the work of breathing by stabilizing alveoli and moving ventilation to a more compliant position on the volume/pressure curve. A study by Saslow et al found improved lung compliance with the use of HFNC in the neonatal population.[13] It might be inferred that similar findings will be forthcoming in the adult population, given the documented presence of CPAP and increased FRC.

HFNC is suggested as a viable therapeutic alternative for providing supplemental oxygen to seriously ill and terminal patients suffering from hypoxemia and conditions requiring noninvasive CPAP. Considering the relatively low cost of many HFNC systems, and the potential for increased patient comfort and adherence compared to conventional noninvasive CPAP systems, respiratory

therapists need to actively promote wider usage of this treatment modality.

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The author has disclosed no conflicts of interest.

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