Arch Bronconeumol. 2019;55(6):291–292

Sociedad Española de Neumología y Cirugía Torácica SEPAR

ARCHIVOS DE Bronconeumología

www.archbronconeumol.org

Editorial

High-Flow Nasal Cannulae. The Quest for the Holy Grail in the Critical Respiratory Patient?☆

Cánulas nasales de alto flujo. ¿El hallazgo del grial en el paciente respiratorio crítico?

Joan R. Masclans,[a,b,c,d,*] Irene Dot,[a,b] Purificación Pérez-Teran[a,b]

[a] *Servicio de Medicina Intensiva, Hospital del Mar, Parc de Salut Mar (PSMAR), Barcelona, Spain*
[b] *Grupo de Investigación en Patología Crítica (GREPAC), Instituto Hospital del Mar de Investigación Médica (IMIM), Barcelona, Spain*
[c] *Departamento de Medicina, Universitat Autònoma de Barcelona (UAB), Barcelona, Spain*
[d] *HISpaFlow (Grupo Español Multidiscipinar de Terapia de Soporte con Alto Flujo en Adultos), Spain*

Respiratory failure (RF) is one of the most frequent causes of admission to intensive care departments, and oxygen administration remains a first-line therapy.[1] The use in recent years of high flow nasal cannulae (HFNC) in patients with both acute and chronic RF appears to be a useful alternative to conventional oxygen therapy (COT) and other non-invasive systems of respiratory support (primarily non-invasive ventilation [NIV]). This technique helps optimize the control of the patient with RF and improves survival.[1] HFNC can be used for the non-invasive administration of a fully conditioned flow of gas (37 °C and 100% relative humidity) of 0–60 L/min with the desired F_IO_2 (0.2–1 L), offering rapid improvement in a significant number of patients.[2]

The most notable contribution of the HFNC active humidification system in mechanically ventilated patients, introduced about 10 years ago, is its excellent clinical tolerance and capacity to significantly reduce the breathing rate in patients with acute RF (ARF),[3] compared to patients receiving COT or NIV.

In the early years, HFNC was indicated mainly on the basis of the benefit perceived from personal experience, and the notion that this was a potentially useful treatment had to be taken in good faith; now, however, there is sufficient evidence to support its use in patients with ARF (high flow with high F_IO_2),[4] and some positive results are beginning to emerge on its use in chronic RF (CRF) (high flow without the need for high F_IO_2), in both the hospital and home care setting.[5]

It is clear that invasive ventilatory support should be avoided wherever possible, due to problems arising from either the artificial airway or the mechanical ventilation (MV) itself. When NIV was introduced, results were initially mixed, but it is now the reference treatment in COPD exacerbations, acute cardiogenic pulmonary edema, and ARF in immunosuppressed patients.[6] However, its use remains controversial in patients with other causes of ARF,[7] although HFNC may also play an important role in these patients, in addition to the standard NIV indications.

Four components are required for the administration of this high flow: first, silicone cannulas (adapters for tracheotomized patients are also available); second, a high-flow administration system to control the administered flow and F_IO_2 (with 2 wall outlets and a mixer flow meter, or a turbine that is separate from the wall outlet); third, a humidifying-warming system; and fourth, non-condensing tubing connecting the humidifier with the patient interface.[2]

Several pathophysiological mechanisms explain the effects of high flow, but the main results achieved with this system are the following[1]: the dilution of the administered O_2 flow with ambient air can be reduced during peak inspiration (which in situations of RF can be >50 bpm[8]), thus ensuring that the real F_IO_2 administered is close to the desired level[2]; a CPAP effect is also achieved, with positive airway pressures ranging between 3 and up to 7–9 cmH_2O, depending on the flow and whether the mouth is open or closed[3]; the flow supplied directly to the nasopharynx flushes CO_2 from the anatomical receptacle, preventing reinhalation and providing a reservoir of fresh gas, thus reducing the anatomical dead space and increasing alveolar ventilation, improving effort tolerance, and reducing dyspnea[4]; the effort required to metabolize the inhaled gas mixture is reduced[5]; active humidification improves mucociliary clearance, facilitating the expulsion of secretions and reducing the formation of atelectasis, which improves the ventilation-perfusion ratio[6]; in addition, the administration of conditioned gas helps reduce upper airway resistance, thus helping to reduce the patient's work of breathing[7]; the high flow also increases the circulating pulmonary volume, which is accompanied by a decrease in respiratory rate, without changes in $PaCO_2$[8]; both this change in the ventilatory pattern,[9] which leads to a reduction of work of breathing,[10] and the generation of intrathoracic positive pressure, with a reduced right ventricular preload, also explain the hemodynamic improvement in patients with heart failure.[11] All these effects, then, together with the

☆ Please cite this article as: Masclans JR, Dot I, Pérez-Teran P. Cánulas nasales de alto flujo. ¿El hallazgo del grial en el paciente respiratorio crítico?. Arch Bronconeumol. 2019;55:291–292.

* Corresponding author.
E-mail address: jrmasclans@psmar.cat (J.R. Masclans).

convenience of the technique, which facilitates oral communication and allows patients to eat without disconnecting the circuit, mean that HFNC achieves improved oxygenation in patients with ARF.[12]

Moreover, with high flows and F_IO_2, all the physiological effects listed above can benefit both patients with COPD exacerbation, without the deleterious effect of high concentrations of oxygen, as shown by some recent studies,[5] and clinically stable patients on home oxygen therapy.

All this suggests that HFNC may well be the Holy Grail of treatment for both acute and chronic RF, and justifies the growing use of this system in intensive care departments, postsurgical resuscitation areas, and emergency and pulmonology departments. This is because it can used as first-line treatment for ARF, in weaning from MV in both acute and postoperative situations,[13] during invasive procedures, and in palliative care. More evidence is still needed on its use in COPD exacerbations, heart failure, and preoxygenation during tracheal intubation. The initial flow and how to decrease it must be protocolized, with special attention given to F_IO_2, in order avoid entering into a hyperoxic spiral, while adjusting SpO_2 according to the situation of each patient.[14] The detection of patients at risk of failure[15] and the effects of this procedure remain to be analyzed in greater depth.

Conflict of interests

Dr. Masclans's research group in the IMIM benefits from the support provided by Fisher & Paykel to a post-doctoral fellowship.

References

1. Matthay MA. Saving lives with high-flow nasal oxygen. N Engl J Med. 2015;372:2225–6.
2. Masclans JR, Pérez-Terán P, Roca O. Papel de la oxigenoterapia de alto flujo en la insuficiencia respiratoria aguda. Med Intensiva. 2015;39:505–15.
3. Roca O, Riera J, Torres F, Masclans JR. High-flow oxygen therapy in acute respiratory failure. Respir Care. 2010;55:408–13.
4. Frat J-P, Thille AW, Mercat A, Girault C, Ragot S, Perbet S, et al. High-flow oxygen through nasal cannula in acute hypoxemic respiratory failure. N Engl J Med. 2015;372:2185–96.
5. Nagata K, Kikuchi T, Horie T, Shiraki A, Kitajima T, Kadowaki T, et al. Domiciliary high-flow nasal cannula oxygen therapy for stable hypercapnic COPD patients: a multicenter. Randomized crossover trial. Ann Am Thorac Soc. 2018;15:432–9.
6. Nava S, Hill N. Non-invasive ventilation in acute respiratory failure. Lancet. 2009;374:250–9.
7. Xu X-P, Zhang X-C, Hu S-L, Xu J-Y, Xie J-F, Liu S-Q, et al. Noninvasive ventilation in acute hypoxemic nonhypercapnic respiratory failure. Crit Care Med. 2017;45:e727–33.
8. Anderson NJ, Cassidy PE, Janssen LL, Dengel DR, Science E. Peak inspiratory flows of adults exercising at light. Moderate and heavy work loads. J Int Soc Respir Prot. 2006;23:53–63.
9. Riera J, Pérez P, Cortés J, Roca O, Masclans JR, Rello J. Effect of high-flow nasal cannula and body position on end-expiratory lung volume: a cohort study using electrical impedance tomography. Respir Care. 2013;58:589–96.
10. Mauri T, Turrini C, Eronia N, Grasselli G, Volta CA, Bellani G, et al. Physiologic effects of high-flow nasal cannula in acute hypoxemic respiratory failure. Am J Respir Crit Care Med. 2017;195:1207–15.
11. Roca O, Pérez-Terán P, Masclans JR, Pérez L, Galve E, Evangelista A, et al. Patients with New York Heart Association class III heart failure may benefit with high flow nasal cannula supportive therapy. High flow nasal cannula in heart failure. J Crit Care. 2013;28:741–6.
12. Roca O, Hernández G, Díaz-Lobato S, Carratalá JM, Gutiérrez RM, Masclans JR. Current evidence for the effectiveness of heated and humidified high flow nasal cannula supportive therapy in adult patients with respiratory failure. Crit Care. 2016;20:109.
13. Hernández G, Vaquero C, González P, Subira C, Frutos-Vivar F, Rialp G, et al. Effect of postextubation high-flow nasal cannula vs conventional oxygen therapy on reintubation in low-risk patients: a randomized clinical trial. JAMA. 2016;315:1354–61.
14. Chu DK, Kim LH, Young PJ, Zamiri N, Almenawer SA, Jaeschke R, et al. Mortality and morbidity in acutely ill adults treated with liberal versus conservative oxygen therapy (IOTA): a systematic review and meta-analysis. Lancet. 2018;391:1693–705.
15. Roca O, Messika J, Caralt B, García-de-Acilu M, Sztrymf B, Ricard JD, et al. Predicting success of high-flow nasal cannula in pneumonia patients with hypoxemic respiratory failure: the utility of the ROX index. J Crit Care. 2016;35:200–5.