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High-flow nasal therapy in adults with severe acute respiratory infection ☆
A cohort study in patients with 2009 influenza A/H1N1v

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Abstract

Purpose: The experience with high-flow nasal cannula (HFNC) oxygen therapy in severe acute respiratory infection (SARI) is limited. The objective was to assess the effectiveness of HFNC oxygen therapy in adult patients with SARI by confirmed 2009 influenza A/H1N1v infection (by real-time reverse transcription polymerase chain reaction testing).

Material and Methods: A single-center post hoc analysis of a cohort of intensive care unit patients admitted with SARI due to 2009 Influenza A/H1N1v was done. High-flow nasal cannula (Optiflow; Fisher & Paykel, Auckland, New Zealand) was indicated in the presence of acute respiratory failure when the patient was unable to maintain a pulse oxymetry more than 92% with more than 9 L/min of oxygen using a standard face mask conventional delivery systems. Nonresponders were defined by their need of subsequent mechanical ventilation.

Results: Twenty-five nonintubated adult patients were admitted for SARI (21 pneumonia). Twenty were unable to maintain pulse oxymetry more than 92% with conventional oxygen administration and required HFNC O_2 therapy, which was successful in 9 (45%). All 8 patients on vasopressors required intubation within 24 hours. After 6 hours of HFNC O_2 therapy, nonresponders presented a lower Pa_{O_2}/fraction of inspired oxygen (median, 135 [interquartile range, 84-210] vs 73 [56-81] mm Hg $P < .05$) and needed higher oxygen flow rate. No secondary infections were reported in health care workers. No nosocomial pneumonia occurred during HFNC O_2 therapy.

Conclusion: High-flow nasal cannula O_2 therapy appears to be an innovative and effective modality for early treatment of adults with SARI.

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1. Introduction

Severe acute respiratory infection (SARI) due to pandemic 2009 influenza A/H1N1v infection was characterized by a rapid acute respiratory failure (ARF), preceded by 3 to 5 days of flu-like symptoms. Data from large cohorts during the pandemic period indicated that 30% of all hospital-admitted patients required intensive care unit (ICU) admission with more than 60% of them being subsequently mechanically ventilated [1,2].

High-flow nasal cannula (HFNC) O_2 therapy is the newest and least known noninvasive option for the clinical management of patients with ARF. Current heated/humidified high flow (up to 50 L/min) devices have achieved a great degree of efficacy and comfort in delivering high-flow oxygen compared with conventional oxygen therapy [3]. Furthermore, improvement in oxygenation with HFNC has been described in patients with mild to severe ARF [3-5]. For these reasons and the comfort provided to the patient, HFNC O_2 therapy appears to be an innovative modality for early treatment of adult patients with severe ARF. Although it has the potential to reduce the need of mechanical ventilation (MV), its indications remain speculative. Information on SARI due to influenza A/H1N1v is limited to 5 patients [4].

Our hypothesis was that HFNC O_2 therapy could be an efficient noninvasive intervention and that it might alleviate the need for MV in some patients with SARI. To evaluate this hypothesis, the clinical course of nonintubated patients with SARI was recorded, with specific focus on those receiving HFNC O_2 therapy who were also compared with control patients already mechanically ventilated on admission. Primary end points were the need for MV and ICU mortality. Secondary objectives of the analysis were to identify a subset of patients most likely to benefit from HFNC O_2 therapy and to anticipate outcomes.

2. Methods

This study represents a post hoc analysis of a prospectively assessed cohort of adult patients admitted with ARF due to 2009 influenza A/H1N1v infection (in the general ICU of Vall d'Hebron University Hospital in Barcelona, a large tertiary university hospital) from September 1, 2009, to January 31, 2011. Patients reported in this study were also reported to a large national registry, which received ethics board approval in July 2009 (ref. 07/J23). Informed consent was waived because of the observational nature of the study. Clinical and epidemiological parameters of this cohort of adult patients, in comparison with pediatric patients admitted with the same indication in Vall d'Hebron University Hospital, have been reported elsewhere [6].

Inclusion criteria were ARF and laboratory confirmation of 2009 influenza A/H1N1v infection by use of real-time reverse transcription polymerase chain reaction testing on nasopharyngeal samples or endobronchial secretions [7,8]. Methodology is described elsewhere [6]. Exclusion criteria were age younger than 18 years, hypercapnia, or lack of confirmation of 2009 A/H1N1v infection.

Demographic data, comorbidities, clinical and laboratory features, severity indices, and radiologic findings were recorded. Clinical and epidemiological criteria were used according to World Health Organization definitions [7,8]. The definitions of community-acquired pneumonia, secondary bacterial pneumonia, and hospital-acquired pneumonia were based on 2007 American Thoracic Society (ATS) and Infectious Disease Society of America (IDSA) guidelines [9]. Primary viral pneumonia was defined in patients presenting during the short-term phase of influenza virus illness with adult respiratory distress syndrome and unequivocal alveolar opacification involving 2 or more lobes, with negative respiratory and blood bacterial cultures. Daily clinical and radiologic assessment was performed by critical care specialists. Hospital-acquired pneumonia was defined according with 2005 ATS/IDSA guidelines [10]. *Barotrauma* was defined as visible pneumothorax in the chest x-ray. *Obese patients* were defined as those with body mass index over 30 kg/m^2 [11]. Consensus criteria were used for the definitions of shock and shock requiring administration of vasopressors [12]. Severity of illness at ICU admission was assessed with Acute Physiology and Chronic Health Evaluation (APACHE) II score [13], which was determined in all patients within the first 24 hours; organ failure was assessed using the Sequential Organ Failure Assessment (SOFA) scoring system [14].

Standard and droplet control measures were adopted for all patients included. Patients were isolated for at least 7 days after onset of illness. Health care workers used special personal protective equipment (PPE), such as filtering face piece (FFP3) masks, gowns, gloves, and eye protection. After each use, PPE was appropriately and safely disposed of after use and careful hand washing was performed. Secondary infections among health care workers were self-reported.

The HFNC O_2 device (Optiflow system, MR850 heated humidified RT202 delivery tubing, and RT050/051 nasal cannula; Fisher & Paykel Healthcare Ltd, Auckland, New Zealand) were applied to provide optimal humidity (37°C, 44 mg/L) was indicated in the presence of ARF when the patient was unable to maintain a pulse oxymetry (SpO_2) more than 92% with more than 9 L/min of oxygen on conventional oxygen administration using a standard face mask (Oxinova, Carburos Medica, Spain) with a bubble humidificator (Respiflo Water and MN Adapter; Tyco Healthcare, Gosport, United Kingdom). Low-resistance nasal cannula available can deliver up to 50 L/min of totally humidified gas admixture. The fraction of inspired oxygen (FIO_2) and flow rate were adjusted to individual patient needs with a target SpO_2 of 95%. Parameters used to assess respiratory failure were respiratory rate (RR), PaO_2/FIO_2 ratio, SpO_2, and $PaCO_2$.