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The clinical practice of high-flow nasal cannula oxygen therapy in adults: A Japanese cross-sectional multicenter survey

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ABSTRACT

Background: High-flow nasal cannula oxygen therapy (HFNC) is widely used mainly in the acute care setting, but limited data are available on real-world practice in adults. The objective of this study was to describe HFNC practices in Japanese adults.

Methods: A retrospective cross-sectional multicenter survey of adult patients receiving HFNC from January through March 2015 was conducted in 33 participating hospitals in Japan.

Results: We obtained information on 321 patients (median age, 76; 218 men, 103 women; median estimated PaO_2/F_IO_2, 178 mm Hg) from 22 hospitals. Do-not-intubate status was determined in 37.4% of patients. Prior to HFNC, 57.9% of patients received conventional oxygen therapy; 25.9%, noninvasive ventilation; and 15.0%, invasive mechanical ventilation. The common indications for HFNC were acute hypoxemic respiratory failure (ARF) (65.4%), postoperative respiratory support (15.9%), and post-extubation respiratory support (11.2%). The underlying etiology of ARF included interstitial lung disease, pneumonia, and cardiogenic pulmonary edema. HFNC was administered mostly in intensive care units or intermittent care units (60.7%) and general wards (36.1%). Median duration of HFNC was

Abbreviations: ARDS, acute respiratory distress syndrome; ARF, acute hypoxemic respiratory failure; COPD, chronic obstructive pulmonary disease; ED, emergency department; F_IO_2, fraction of inspired oxygen; HFNC, high-flow nasal cannula oxygen therapy; ICU, intensive care unit; IMCU, intermediate care unit; IMV, invasive mechanical ventilation; NIV, noninvasive ventilation; $PaCO_2$, partial pressure of arterial carbon dioxide; PaO_2, partial pressure of arterial oxygen; RCT, randomized controlled trial; SpO_2, peripheral capillary oxygen saturation

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4 days; median total flow rate, 40 L/min; and median F_IO_2, 50%. HFNC significantly improved PaO_2, $PaCO_2$, SpO_2 and respiratory rate from baseline. Two-thirds of patients finally survived to be discharged or transferred.

Conclusions: We documented patient demographics, clinical indications, and settings of HFNC use in the real world. We also demonstrated positive effects of HFNC on respiratory parameters. Further studies are urgently needed regarding the efficacy and safety of HFNC in populations outside of previous clinical trials.

1. Introduction

High-flow nasal cannula oxygen therapy (HFNC), which delivers high flows of blended, humidified oxygen through a nasal cannula, is a promising tool for respiratory support. The key mechanisms of action of HFNC are effective delivery of up to 100% oxygen, washout of the pharyngeal dead space, decreased inspiratory resistance, airway hydration, and positive end-expiratory pressure effect [1]. Several clinical trials have demonstrated the effectiveness of HFNC in a variety of clinical situations, such as acute hypoxemic respiratory failure (ARF), post-cardiac surgery, post-extubation, and during invasive procedures [2–6].

In Japan, HFNC was introduced around 2012 [7] and is now widely used in clinical practice. Although it has become globally popular and several studies of HFNC have now been published, there remain few data on real-world practice in adults, such as details of patient demographics, clinical indications, and settings for its use. There are no well-established guidelines thus far available for applying HFNC. Therefore, we performed the first multicenter survey in Japan to ascertain the practical application of HFNC in adults.

2. Patients and methods

2.1. Study population

We conducted a retrospective, cross-sectional, multicenter survey in Japan. We contacted institutions listed in the Japanese Respiratory Society registry, which had experience with and maintained records of HFNC use. We identified 33 hospitals distributed throughout Japan that expressed an intent to participate in our study. All patients aged $>$ 18 years, admitted to participating hospitals, and treated with HFNC from January through March 2015 were considered eligible for the study, regardless of underlying disease, clinical situation, or the type of device used to deliver HFNC.

We developed a structured electronic questionnaire with multiple choice responses, consisting of the following 5 components:

1) Demographics: age and sex; do-not-intubate status prior to HFNC use; underlying disease; clinical indications for HFNC (ARF, postoperative respiratory support, post-extubation respiratory support, palliative care, or others).
2) Baseline respiratory characteristics –respiratory support prior to HFNC use [none, conventional oxygen therapy, noninvasive ventilation (NIV), invasive mechanical ventilation (IMV), or others]; arterial blood gas data including pH, partial pressure of arterial carbon dioxide ($PaCO_2$), and partial pressure of arterial oxygen (PaO_2) assessed within 24 hours prior to HFNC use; vital signs including peripheral capillary oxygen saturation (SpO_2), respiratory rate, systolic blood pressure, and heart rate assessed within 24 hours prior to HFNC use. Conventional oxygen therapy was delivered via standard nasal cannula, simple face mask, Venturi mask, or non-rebreather mask. We estimated PaO_2/F_IO_2 in patients with standard nasal cannula, simple face mask, and non-rebreather mask using the formula: estimated F_IO_2 = (oxygen flow L/min) $\times$ 0.03 + 0.21 [2].
3) Clinical use of HFNC: setting [intensive care unit (ICU), intermediate care unit (IMCU), general ward, or emergency department (ED)]; total flow rate and the fraction of inspired oxygen (F_IO_2) at the beginning of HFNC use; duration of HFNC use. We defined IMCU as a lesser intensive care monitoring setting other than general ward and included coronary-care units, stroke-care units, high-care units, and emergency wards. HFNC in the ED referred to HFNC use for walk-in patients prior to admission.
4) Respiratory parameters after HFNC use: response to HFNC (improved, worsened, or others); respiratory support after HFNC use; arterial blood gas data and vital signs within 6 h from commencement of HFNC.
5) Outcome: status at discharge (discharged home, transferred, or in-hospital death); complications (skin breakdown, pneumothorax, mediastinal emphysema, pneumonia, or others).

The questionnaires were sent out in March 2016 to the 33 hospitals. Experts in the field of respiratory management at each hospital were requested to respond to the questionnaire. E-mail reminders were sent to non-respondents. In case of incomplete information, further contact was made to acquire missing data. Data collection was closed in September 2016. The use of the patient data was approved by the Institutional Review Board at each participating hospital.

2.2. Statistical analysis

Continuous variables with non-parametric distribution are presented as medians (with interquartile range). Categorical variables are presented as number (%). The Wilcoxon signed-

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