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Case report

High-flow nasal cannula oxygen therapy for acute exacerbation of interstitial pneumonia: A case series

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ABSTRACT

We report 3 cases (all men, age: 69–81 years) of acute exacerbation of interstitial pneumonia (AEIP) that were successfully treated with a high-flow nasal cannula (HFNC), which delivers heated, humidified gas at a fraction of inspired oxygen (FIO_2) up to 1.0 (100%). Oxygenation was insufficient under non-rebreathing face masks; however, the introduction of HFNC with an FIO_2 of 0.7–1.0 (flow rate: 40 L/min) improved oxygenation and was well-tolerated until the partial pressure of oxygen in blood/FIO_2 ratio increased (between 21 and 26 days). Thus, HFNC might be an effective and well-tolerated therapeutic addition to the management of AEIP.

1. Introduction

Acute exacerbation of interstitial pneumonia (AEIP) is the leading cause of death in patients with idiopathic pulmonary fibrosis (IPF) [1]. AEIP can also occur in patients with other types of interstitial pneumonia, and is often complicated by severe hypoxemia. However, the prognosis of patients treated with invasive mechanical ventilation for AEIP is poor [2–7].

Abbreviations: AEIP, acute exacerbation of interstitial pneumonia; HFNC, high-flow nasal cannula; FIO_2, fraction of inspired oxygen; PaO_2, partial pressure of oxygen in blood; IPF, idiopathic pulmonary fibrosis; NPPV, non-invasive positive pressure ventilation; CT, computed tomography

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A few studies with small sample sizes suggest that non-invasive positive pressure ventilation (NPPV), which avoids the complications associated with endotracheal intubation, may improve the prognosis in these patients [8–10].

The high-flow nasal cannula (HFNC) is a new oxygen-delivery device, in which heated and humidified inspired gas with a high flow rate (up to 60 L/min) enables a rise in the fraction of inspired oxygen (FIO_2) to 1.0 (100%). Evidence of the usefulness of HFNC for the treatment of patients presenting with pneumonia or respiratory distress syndrome is accumulating in both infants and adults [11–13]. A randomized controlled trial demonstrated that HFNC is not inferior to NPPV in the management of acute respiratory failure due to alveolar lung diseases such as pneumonia and lung edema [14].

HFNC may be more suitable for the management of acute respiratory failure due to AEIP than in cases with pulmonary edema or acute exacerbation of chronic obstructive pulmonary disease, in which higher positive end-expiratory pressure and/or ventilatory support is required. However, little is known about its efficacy and tolerability in the management of AEIP except for a single case report [15]. Herein, we report 3 cases of AEIP successfully treated with HFNC.

2. Case reports

2.1. *Patient 1*

A 69-year-old man with a 30 pack-year smoking history presented with rapidly increasing cough and dyspnea on exertion for 1 week before his admission to the hospital. The partial pressure of oxygen in blood (PaO_2) upon presentation to the emergency room was 68 Torr on 5 L/min of O_2 inhaled through a face mask, with 33 Torr of $PaCO_2$, and a pH of 7.47 on arterial blood gas analysis. The patient's vital signs were as follows: body temperature, 37.4 °C; blood pressure, 121/82 mmHg; pulse rate, 108/min; and respiratory rate, 30 breaths/min. Fine crackles were audible in both lower lung fields. Neither clubbing nor leg edema was present.

The peripheral blood leukocyte count, serum lactate dehydrogenase (LDH), C-reactive protein (CRP), and Krebs von den Lungen-6 (KL-6) concentrations were elevated (Table 1). The chest radiographic image showed an interstitial shadow in both lung fields, and a thoracic computed tomography (CT) scan showed ground glass opacities and infiltrations in both lung fields, as well as traction bronchiectasis and centrilobular emphysema in the absence of honeycombing (Fig. 1). The patient was diagnosed with acute exacerbation of unclassified interstitial pneumonia with emphysema, and high-dose methylprednisolone (1000 mg/day) was administered for 3 days, followed by 60 mg/day of prednisolone. On day 3, his respiratory condition and PaO_2/fraction of inspired oxygen (FIO_2) ratio [16,17] had further deteriorated despite the delivery of a maximal dose of oxygen via a non-rebreathing face mask with a reservoir (Table 1, Fig. 2). A trial of NPPV was not tolerated. The patient was treated by using HFNC at a flow rate of 40 L/min, with an FIO_2 of 0.8, in order to improve oxygenation; high-dose cyclophosphamide (500 mg) was administered on days 7 and 21. The PaO_2/FIO_2 ratio increased gradually (Fig. 2), and HFNC was replaced by oxygen delivery through a nasal cannula on day 21. The patient was discharged from the hospital without supplemental oxygen therapy. His respiratory symptoms have not worsened for 20 months.

Table 1 – Demographic and laboratory characteristics of 3 patients.

	Patient		
	1	2	3
Age, gender	69, male	73, male	81, male
Smoking history, pack-year	30	50	30
Days before the onset of treatment	7	10	3
Laboratory data of blood at exacerbation			
White blood cell counts, $\times 10^3/\mu L$	20.7	13.0	13.5
Lactate dehydrogenase, IU/L	443	640	678
Krebs von den Lungen-6, U/mL	1007	1448	2299
Brain natriuretic peptide, pg/mL	14	36	349
Oxygen delivery, respiratory rate, and blood gas analysis (before HFNC)			
Flow in non-rebreathing face mask, L/min	10	10	10
Respiratory rate	27	27	38
PaO_2, Torr	70	59	48
PaO_2/FIO_2	88	65	63
$PaCO_2$, Torr	43	27	29
pH	7.44	7.45	7.42
Oxygen delivery, respiratory rate, and blood gas analysis (after HFNC)			
Flow in HFNC, L/min	40	40	40
FIO_2, %	0.8	1.0	0.7
Respiratory rate	21	21	25
PaO_2, Torr	125	297	80
PaO_2/FIO_2	156	297	114
$PaCO_2$, Torr	44	26	29
pH	7.45	7.47	7.43

2.2. *Patient 2*

A 73-year-old man who had a 50-pack-year smoking history was transferred to our hospital for evaluation of fever and progressive dyspnea that was refractory to antibiotic treatment. A retrospective review of the patient's thoracic CT obtained 2 years prior to admission showed unclassified interstitial pneumonia with emphysema. Serum levels of LDH, CRP, and KL-6 were elevated (Table 1), and his thoracic CT on admission showed ground glass opacities and infiltrations in both lung fields, consistent with AEIP, and a 9-mm nodule in the left lower lobe (Fig. 1).

A high-flow nasal cannula was introduced at a flow rate of 40 L/min and an FIO_2 of 1.0, along with high-dose corticosteroid and cyclophosphamide therapy. The PaO_2/FIO_2 ratio gradually increased, and HFNC was discontinued on day 21. The patient was prescribed long-term oxygen therapy and was discharged on day 70. He died of lung cancer 6 months later.