

BRIEF COMMUNICATION

Comparison of High-flow Oxygen Therapy using Nasal Canula with Standard Oxygen Therapy using Face Mask in Patients with Acute Hypoxemic Respiratory Failure

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ABSTRACT

Introduction: High-flow oxygen therapy through nasal cannula is a technique whereby heated and humidified oxygen is delivered to nose at high flow rates and this generates low levels of positive pressure in upper airways. This may decrease physiological dead space by flushing expired CO₂ from the upper airway, a process that explains the decrease in the work of breathing. With this we determine whether high-flow oxygen therapy as compared with standard oxygen therapy alone could reduce the rate of endotracheal intubation and outcomes.

Materials and methods: We performed a prospective randomized trial in our intensive care unit (ICU), in which we randomly assigned patients with acute hypoxemic respiratory failure without hypercapnia into two groups. A total 30 patients were taken in our study and were randomly allocated to groups I and II (15 in each group) with type I respiratory failure.

- *Group I:* Received high-flow oxygen therapy using nasal cannula
 - *Group II:* Treated with standard oxygen mask therapy
- The outcome of two groups was compared in terms of PaO₂ and the proportion of patients who needed reintubation.

Results: Demographic data (Table 1) were not significant between the two groups. Arterial blood gas (ABG) analysis (Table 2) showed PaO₂ of 92 ± 32 mm Hg in high-flow nasal oxygen (group I) receiving patients compared with PaO₂ of 85 ± 31 mm Hg in standard oxygen therapy patients (group II). The intubation rate (Table 2) was 46% (7/15) in high-flow nasal oxygen group (I) and 66% (10/15) in the standard oxygen therapy group (II).

Conclusion: Patients with nonhypercapnic acute hypoxemic respiratory failure treatment with high-flow nasal oxygen have significantly better outcome compared with oxygen therapy with the standard oxygen therapy with face mask.

Keywords: High-flow oxygen therapy, Nasal canula, Nonhypercapnic acute hypoxic respiratory failure.

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INTRODUCTION

Oxygen therapy with high flow through nasal cannula is a technique that delivers heated and humidified oxygen to the patient's nose at high flow rates which results in low levels of positive pressure in the upper airways. It may decrease physiological dead space by flushing expired CO₂ from the upper airway, ultimately resulting in decreased work of breathing.¹

There is lot of progress and complexities in the field of modern mechanical ventilators. This advancement is lacking in technology to efficiently warm and humidify respiratory source gases. The process of insufficient humidification has limited use of high supplemental gas flow rates delivered through the nose. The addition of sufficient warmth and high levels of humidification to the inhaled gas have allowed for higher flow rates from nasal cannula devices to be used in critical patients. Patients with different health care problems and ranging in ages from preterm newborns to adults are now getting flow rates ranging from 2 to 40 L/min to support their ventilation. In adults, these devices are used in a variety of clinical settings postextubation, such as pulmonary edema, chronic obstructive pulmonary disease (COPD), and acute respiratory distress syndrome, with high success rates.²

AIM

To determine whether high-flow oxygen therapy as compared with standard oxygen therapy alone could reduce the rate of endotracheal intubation and its effect on ABGs.

MATERIALS AND METHODS

A prospective randomized trial in our ICU, approved by the ethical committee of our hospital.

Written informed consent was obtained from all the patients.

A total of 30 patients were taken in our study and were randomly allocated to groups I and II with type I respiratory failure using envelope method.

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- A total of 15 patients were allocated in each group.
- *Group I:* Received high-flow oxygen therapy using nasal canula
 - *Group II:* Treated with standard oxygen therapy.

Inclusion Criteria

- A total of 18 years of age or older
- Respiratory rate of more than 25 breaths per minute
- Partial pressure of arterial carbon dioxide not higher than 45 mm Hg
- Absence of clinical history of underlying chronic respiratory failure.

Exclusion Criteria

- PaCO₂ of more than 45 mm Hg
- Exacerbation of asthma or chronic respiratory failure
- Cardiogenic pulmonary edema
- Hemodynamic instability
- Glasgow coma scale of less than 12
- Urgent need for endotracheal intubation.

The outcome of two groups was compared in terms of PaO₂ and the proportion of patients who needed intubation at day 15.

RESULTS

Demographic data (Table 1) were not significant between the two groups.

The ABG analysis (Table 2) showed PaO₂ of 92 ± 32 mm Hg in high-flow nasal oxygen (group I) receiving patients compared with PaO₂ of 85 ± 31 mm Hg in standard oxygen therapy patients (group II).

Table 1: Demographic characteristics of the patients who participated in the study (mean ± SD)

Characteristics	I (n = 15)	II (n = 15)	p-value
Age (years)	54.31 ± 6.03	53.82 ± 6.92	0.632
Male gender [n (%)]	8 (53.4)	7 (46.6)	1.100
BMI (kg/m ²)	24.42 ± 4.63	25.09 ± 5.12	0.326
APACHE II	27.42 ± 4.73	26.29 ± 6.02	0.316
COPD [n (%)]	7 (46.6)	8 (53.4)	0.840
Asthma [n (%)]	9 (8.93)	6 (7.41)	1.000
Smoking history [n (%)]	8 (53.4)	7 (46.6)	0.369
PaO ₂ (mm Hg)	95.37 ± 12.42	92.59 ± 18.49	0.355
PaCO ₂ (mm Hg)	41.73 ± 6.33	43.52 ± 4.93	0.102
Postsurgical ventilation duration (hour)	2.13 ± 0.43	2.18 ± 0.32	0.492

Table 2: Reintubation and ABG analysis rates in group I compared with group II 72 hours following extubation, n (%)

Characteristics	I (n = 15)	II (n = 15)	p-value
ABG (PaO ₂)	93 ± 22	86 ± 20	0.027
Reintubation	7/15 (46%)	10/15 (66%)	0.121

The intubation rate (Table 2) was 46% (7/15) in high-flow nasal oxygen group (I) and 66% (10/15) in the standard oxygen therapy group (II).

DISCUSSION

In this randomized, open-label trial, high-flow nasal oxygen therapy decreased the rate of intubation compared with standard oxygen therapy.

When planning the study, we assumed an intubation rate of 55% in the standard oxygen group based on the data from previous randomized controlled trial.

Our research showed increased rate than expected in the standard oxygen group.

Two studies have also suggested that a failure of non-invasive ventilation might result in excess mortality, possibly because of delayed intubation.

High-flow oxygen therapy was also associated with:

- An increased degree of comfort,
- A reduction in severity of dyspnea, and
- Decreased respiratory rate.

These findings are a result of:

- The process of warming and humidification of inspired gases which prevented drying of secretions, thickening of secretions, and later atelectasis.
- Producing relatively low levels of positive end-expiratory pressure generated by a high gas flow rate and flushing of upper airway dead space.

High-flow oxygen through nasal cannula is now a viable option because of devices that completely warm and humidify inspiratory gases to body temperature and because 100% saturation is available. It also provides patient comfort and minimizes deterioration of nasopharyngeal structures.

The mechanism of action of high-flow oxygen is as follows:

- It flushes dead space of the nasopharyngeal cavity allowing for better ventilation as well as oxygenation¹
- It reduces inspiratory work of breathing³
- It also improves lung and airway mechanics by eliminating the effects of drying and cooling⁴
- It reduces and eliminates the metabolic cost of gas conditioning
- It also can be used to provide end distending pressure.⁵

CONCLUSION

Following conclusions can be drawn from our study:

- Treatment with high-flow oxygen has significantly better outcome compared with standard oxygen therapy with face mask in patients with nonhypercapnic acute hypoxemic respiratory failure.
- Requirement of mechanical ventilation was also reduced in patients treated with high-flow oxygen.

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