ABENHA MEDICAL JOURNAL bmj
Print ISSN 1110-208X
Online ISSN 2357-0016

Original article

High Flow Nasal Cannula versus Non -Invasive Ventilation in Hypercapnic acute exacerbation of COPD

Amira H. Allam, Ahdaf A. Enan, Kholud M. Doyef , Abeer M. Rawy, Etemad A. Mohammed

Department of Chest, Faculty of Medicine, Benha University, Egypt.

Corresponding to: Kholud M. Doyef, Department of Chest, Faculty of Medicine Benha University, Egypt.

Email:

kholudmohyee@gmail.com

Received:8 September 2024

Accepted:6 October 2024

Abstract

Background: Chronic obstructive pulmonary disease is a common and treatable disease. It is characterized by progressive airflow narrowing. Traditional oxygen therapy often inadequately addresses severe hypoxia or hypercapnia in COPD patients. Non-invasive ventilation became the standard treatment. However, NIV masks can cause discomfort and intolerance, leading to treatment failure. High-flow nasal cannula (HFNC) offers a promising alternative by delivering heated, humidified oxygen with precise control, improving ventilation, oxygenation, and patient comfort. **This study aims** to compare the efficacy of HNFC versus NIV in managing patients with hypercapnic acute exacerbation of chronic obstructive pulmonary disease. **Methods:** This prospective randomized controlled trial was conducted at respiratory intensive care unit at Benha University Hospital between January 2023 to January 2024.Forty patients were randomized into observational group A (use HFNC, n=20) and control group B (use NIV low- flow o2, n=20). **Results**: There was no significant difference between both studied groups regarding outcome after therapy; 70% of cases treated with HFNC versus 80% of cases exposed to NIV improved, and there were no differences in respiratory support duration, length of ICU and hospital stay between both groups. However, a significantly higher number of patients reported comfort with HFNC compared to NIV and the prevalence of noisiness was significantly higher in the NIV group. **Conclusion:** HFNC was non-inferior to NIV regarding ABG parameters during or after therapy, duration of support, ICU or hospital stay and outcome (including treatment failure and mortality). However, HFNC was better than NIV regarding patient comfort during therapy.

Keywords: COPD, exacerbation, HFNC, NIV

Introduction

Chronic Obstructive Pulmonary Disease (COPD) disease with chronic respiratory symptoms (dyspnea, cough, and expectoration) caused by abnormalities of the airways (bronchitis, bronchiolitis) and/or alveoli (emphysema) that leads to constant, usually progressive, airflow limitation (1).

Low-flow oxygen was used for treatment of COPD for long time . However, sometimes patients' hypoxia or hypercapnia are difficult to handle. by time, noninvasive ventilation (NIV) has gradually become the gold standard for the management of patients with acute exacerbation of COPD and type II respiratory failure (2).

Nevertheless , NIV masks and nasal masks has its own drawbacks as facial compression influencing patient' communication, eating and sleep (3).The poor comfort and mask intolerance can readily lead to tracheal intubation and cause NIV treatment failure (4).

High-flow nasal cannula (HFNC) is a recent kind of noninvasive respiratory assistance technique that can decrease PaCO2 benefitting from the flushing effect of high flow. Oxygen flow and oxygen concentration can be tailored to avoid the high concentration of oxygen inducing respiratory depression in COPD patients (5, 6).

HFNC can enhance ventilation and oxygenation through delivering an accurate oxygen concentration. Also it improve patient comfort by delivering heated and humidified oxygen (7). Based on previous studies, using HFNC oxygen therapy for COPD patients can decrease the exacerbation rate and enhance exercise capacity and quality of life (8). (9).

The aim of this work is to compare the efficacy of high flow nasal cannula versus non-invasive ventilation in the management patients with hypercapnic acute exacerbation of chronic obstructive pulmonary disease (COPD).

Patients and methods

This is a prospective randomized controlled study conducted at Respiratory Intensive Care Unit at Benha University Hospital on patients with AECOPD with respiratory failure type 2 (PaCO2 > 45 mmHg). Forty patients were 1:1 randomized in the intervention group A (use of HFNC, n = 20) and in the control group B (use of NIV low-flow O_2, n = 20) in the period between January 2023 to January 2024.

An informed written consent was obtained from the patients. Every patient received an explanation of the purpose of the study and had a secret code number. The study was done after being approved by the Research Ethics Committee, Faculty of Medicine, Benha University.

Inclusion criteria were patients with AECOPD with PH: 7.25-7.35, partial pressure of carbon dioxide in the arterial

blood (PaCO2) ≥45mmHg, accepting the whole course of treatment in the hospital, being conscious and able to breathe spontaneously and being informed and willing to participate in the research.

Exclusion criteria were children< 18 years, or patients with PH< 7.20, cancer, neuromuscular disorders, multiple organ failure or mental/psychological disorders.

Method of randomization:

The aim of randomization is to prevent researchers, physicians, and patients from anticipating, and thus affecting, which treatment was given to which patients. Concealing the future allocation sequence from researchers and participants can prevent this (10). The randomization sequence was done using computer-generated system (Sealed envelope.com), where patients were randomized into group A or group B using random permuted blocks, block sizes were 4,6,8. Allocation concealment was done by using sealed opaque sequentially numbered envelopes.

Method of allocation concealment

We obtained 40 identical, opaque, letter-sized envelopes; 40 sheets of standard-size paper; 40 letter-size sheets of single-sided carbon paper; and 2 rolls of household aluminum cooking foil. We purchased a plastic container large enough to hold all 40 envelopes (11, 12). Envelopes were opened sequentially (from lowest to next highest number). The patient's study identifier (patient study number), the date, and their signature were written on the front of the envelope. The carbon paper inside the envelope transferred both the patient identifier, date, and their signature to the treatment allocation paper inside.

This allocation concealment had two values; participants were unaware of their group assignments, investigators and outcome assessors were also blinded to group assignments, distribution of envelopes was done by a third person (12).

All studied cases were subjected to the following:

Detailed history taking, including [age, sex, occupation, smoking and other special habits of medical importance, smoking index]. **Full clinical examination: General examination including** [vital signs (blood pressure, respiratory rate, temperature, pulse, oxygen saturation), local chest examination].

Routine laboratory investigations [complete blood count, arterial blood gases, kidney function tests and liver function tests].

Radiological investigations. Upon admission, all patients received standard treatment for their underlying primary diseases, coupled with mucolytics, anti-infective, and bronchodilator therapies, in the **control group**, patients underwent non-invasive ventilation, the ventilator operated in synchronized/timed mode,

delivering positive pressure ventilation through an oronasal mask. Initial parameters were set as follows: The inspiratory positive airway pressure (IPAP) was set at 10 cm H2O and expiration pressure was set at 5 cm H2O at beginning, and gradually increased after the patient adapted. FiO2 was adjusted to ensure target oxygen saturation at 88-92%. Patients in the **observational group** received HFNO using the VAPOTHERM, INC, 100 Domain Drive Exeter, the initial flow delivered with HFNC was [30--35] L/min then was titrated up to the highest flow compatible with patient comfort (maximum allowed between 50-60 L/min). The FiO2 was titrated to achieve peripheral oxygen saturation (SpO_2) target between 88 and 92%. The air temperature was set at 37°C.

For assessment of patient satisfaction we used a tolerability questionnaire at the end of therapy similar but instead of using a five point scale for each item we used a yes or no question and we count patients giving a (yes) response to the item; items used in questionnaire were comfort, heaviness of nasal interface, noisiness, dryness of nasal passage and ease of breathing. Endpoints to evaluate after HFNC or NIV therapy were mortality rate, length of hospital stay, change of PH, PaCO2, PaO2, intubation which was indicated in: Sever respiratory distress, accessory muscle use or abdominal paradox and change of mentation or level of consciousness (13)

Approval Code: MS 38-1-2023

Statistical analysis

Statistical analysis was done by SPSS v26 (IBM Inc., Armonk, NY, USA). Quantitative variables were presented as mean and standard deviation (SD) and compared between the two groups utilizing unpaired Student's t- test. Qualitative variables were presented as frequency and percentage (%) and were analyzed utilizing the Chi-square test or Fisher's exact test when appropriate. Correlation coefficient (r) was used for detection of correlation between two quantitative variables in one group. Kaplan Meier curve was used to show the Cumulative failure rate. A two tailed P value < 0.05 was considered statistically significant.

Results

This study was performed on 40 patients with AECOPD with a mean age of 60.2 ±11.2 years, 35% were smokers, 42.5% were ex-smokers, and 22.5% were nonsmokers, 31 (77.5%) of studied cases were males. No significant difference between both groups regarding baseline criteria, vital signs assessed on admission and laboratory investigations of studied cases. **Table 1**

Thirty patients out of the 40 involved completed the study till the end and discharged from ICU and then from the hospital while 10 patients failed. In HFNC group, 6 patients had failed treatment, 4 intubated and 2 died while in NIV group, 4 patients failed treatment and had been intubated of whom 2

patients died and 2 patients improved on invasive mechanical ventilation. Patients were intubated due to worsening of ABG parameters, severe respiratory distress and/or change in mentation. There was no significant difference between both studied groups regarding ABGs parameters assessed before starting therapy, after 12 hours, 5 days of starting therapy, at end of therapy and on discharge. **Table 2**

No significant difference was found between both studied groups regarding outcome after therapy, 70% of studied cases treated with HFNC improved versus 80% of cases exposed to NIV and there was no difference in respiratory support duration, length of ICU and hospital stay between both groups.

There was a higher number of patients who were comfortable during treatment with HFNC (75%) compared to NIV (40%). The prevalence of noisiness was also higher among NIV patients as compared to those in the HFNC group (50% versus 10%), with statistically significant difference (P 0.03,0.006 respectively). There was no significant difference between both groups regarding heaviness of nasal interface, dryness of nasal passage or ease of breathing, **Table 3**.

For NIV group, there was no significant correlation between support time, ICU admission time& hospital stay on one side and vital signs, ABG parameters of patients upon admission on the other side, except for pH which was correlated positively with all durations. There was also no correlation between NIV device support parameters and support time, ICU admission time& hospital stay except for FIO2 that was significantly correlated positively with all durations. **Table 4**

For HFNC group, there is no significant correlation between support time, ICU admission time& hospital stay on one side and vital signs, ABG parameters of patients upon admission on the other side, except for PO2 that was correlated positively with all durations. There was also no correlation with HFNC device support parameters, except for FIO2 that was significantly correlated positively with all durations**, Table 4**.

Cumulative failure rate of the HFNC group was 30% (6 cases out of 20) with shorter respiratory support time (mean= 9.71 days), while for the NIV group failure rate was 20% with longer respiratory support duration (mean =21.1 days) but not reach significant level (Log Rank test 2.51, P=0.113). **Figure 1**

Cumulative failure rate of the HFNC group was higher than that of NIV group with longer hospital stay duration but not reach significant level (Log Rank test 0.018, P=0.893). **Figure 2**

Table 1: Comparison of baseline criteria between studied groups.

		NIV N=20		HFNC N=20		P
		Mean ± SD				
Age\ years(60.2 ±11.2)		64.8 ± 11.1		67.7 ± 11.4		0.411
		N	%	N	%	
Gender	**Male**	16	80	15	75	0.705
	Female	4	20	5	25	
Co morbidities	**No**	6	30	6	30	----
	DM	6	30	7	35	0.665
	Hypertension	4	20	6	30	0.765
	HF	8	40	7	35	0.704
	KD	2	10	1	5	0.543
Smoking state	**Non smoker**	5	25	4	20	0.749
	Ex-smoker	9	45	8	40	
	Smoker	6	30	8	40	
Radiology	**Hyperinflation**	16	80	19	95	0.992
	Corpulmpnale	7	35	8	40	0.704
ECG	**Normal sinus**	12	60	17	85	0.213
	Sinus tachy	5	25	5	25	----
	Controlled AF	1	5	0	0	0.991
Vital Signs		Mean ± SD				
Systolic BP (mm\Hg)		120 ± 15.2		117.5 ± 14.1		0.593
Diastolic BP (mm\Hg)		78 ± 11.8		76.5 ± 9.26		0.642
RR (cycle/min)		30.4 ± 5.37		30.3 ± 7.15		0.940
Pulse (b/min)		92.1 ± 11.9		88.5 ± 9.81		0.293
Temperature (^{o}C)		37.3 ± 0.48		37.1 ± 0.34		0.07
SaO_2 %		72.9 ± 9.5		72.7 ± 10.7		0.973
Laboratory Data						
Hb (g/dL)		13.6 ± 1.97		13.4 ± 1.74		0.499
RBCs ($x10^6/mm^3$)		5.28 ± 1.13		5.04 ± 0.94		0.768
WBCs ($x10^3/mm^3$)		10.8 ± 4.98		10.1 ± 3.98		0.445
HCT (%)		44.7 ± 7.27		43.8 ± 5.54		0.648
Platelets ($x10^3/mm^3$)		285.8 ± 97.1		265.3 ± 86.4		0.327
Albumin (g/L)		3.85 ± 0.48		4.01 ± 0.42		0.254
ALT (µIU\ml)		29.8 ± 40.72		20.2 ± 8.82		0.414
AST (µIU\ml)		22.4 ± 10.59		24.1 ± 9.95		0.183
Urea (mg\dl)		71.6 ± 63.8		44.5 ± 29.1		0.150
Creatinine (mg\dl)		1.16 ± 0.71		0.94 ± 0.53		0.273

Table 2: Difference in ABG parameters of both studied groups**.**

	HFNC N=20	**NIV N=20**	**t-test**	**P**
	Mean ± SD			
	Before therapy			
pH (mm\Hg)	7.28 ± 0.02	7.28 ± 0.04	0.724	0.433
$PaCO_2$ (mm\Hg)	73 ± 11.3	70.5 ± 8.96	0.808	0.424
HCo_3(mEq/L)	33.4 ± 5.53	32.3 ± 5.85	0.535	0.595
PaO_2(mm\Hg)	78.9 ± 25.5	81. ± 34.8	0.054	0.968
SPO_2%	91.1 ± 5.34	91.2 ± 5.72	0.057	0.955
After 12 hours of therapy				
pH (mm\Hg)	7.29 ± 0.08	7.30 ± 0.09	0.525	0.603
$PaCO_2$ (mm\Hg)	68.3 ± 19.8	66.1 ± 16.96	0.395	0.695
HCo_3(mEq/L)	30.4 ± 5.39	33.04 ± 7.95	1.22	0.231
PaO_2(mm\Hg)	83.3 ± 45.5	73.9 ± 15.3	0.230	0.820
SPO_2%	90.5 ± 5.95	90.6 ± 5.12	0.061	0.996
After 5 days of therapy				
pH (mm\Hg)	7.37 ± 0.05	7.37 ± 0.05	0.173	0.864
$PaCO_2$ (mm\Hg)	60.6 ± 7.76	63.8 ± 21.4	0.581	0.569
HCo_3(mEq/L)	32.7 ± 5.54	35.95 ± 8.51	1.33	0.196
PaO_2(mm\Hg)	71.1 ± 10.4	68.4 ± 13.2	0.654	0.518
SPO_2%	91.1 ± 3.87	90 ± 5.09	0.726	0.473
At end of therapy				
pH (mm\Hg)	7.41 ± 0.04	7.39 ± 0.87	1.02	0.324
$PaCO_2$ (mm\Hg)	53.1 ± 6.77	61.5 ± 10.3	0.127	0.91
HCo_3(mEq/L)	31.2 ± 4.53	31.9 ± 6.27	0.356	0.727
PaO_2(mm\Hg)	77.8 ± 13.3	69.6 ± 12.1	1.77	0.09
SPO_2%	92.9 ± 3.23	92.4 ± 1.82	0.494	0.627
At discharge from ICU				
pH (mm\Hg)	7.42 ± 0.04	7.42 ± 0.07	0.261	0.796
$PaCO_2$ (mm\Hg)	47.6 ± 5.71	49.4 ± 10.1	0.611	0.546
HCo_3(mEq/L)	30.1 ± 3.41	30.4 ± 6.25	0.195	0.847
PaO_2(mm\Hg)	76.1 ± 10.97	72.2 ± 13.3	0.894	0.379
SPO_2%	93.1 ± 1.87	92.8 ± 2.84	0.452	0.655

Table 3: Outcome, Respiratory support duration, ICU and Hospital stay and satisfaction of the studied groups.

	HFNC N=20	NIV N=20	P value
Improved	14 (70%)	16 (80%)	0.465
Failed	6 (30%)	4 (20%)	
Died	2 (10%)	2 (10%)a	-----
Intubated & survived	4 (20%)	2 (10%)	------
Respiratory support duration\ days	5.85 ± 2.85	6.85± 6.95	0.563
ICU duration\ days	12.3 ± 5.85	12.6 ±6.72	0.884
Hospital stay \ days	15.1 ± 5.81	15.4 ± 6.57	0.925
Patient Satisfaction			
Comfortable	15(75%)	8(40%)	0.03*
Heaviness of nasal interface	6(30%)	5(25%)	0.724
Noisiness	2(10%)	10(50%)	0.006*
Dryness of nasal passage	7(35%)	5(25%)	0.491
Ease of breathing	10(50%)	9(45%)	0.755

a: they died after period of intubation *significant

Table 4: Correlations between vital signs, ABG parameters, Support parameters on admission & (support time, ICU admission time &Hospital stay) For NIV Device and HFNC Device

	Support time	ICU admission time	Hospital stay
	r (P- value)		
NIV Device			
Vital signs			
Respiratory rate	0.112 (0.544)	0.289 (0.112)	0.123 (0.232)
Heart rate	0.076 (0.771)	0.322 (0.091)	0.077 (0.766)
Blood pressure	0.194 (0.421)	0.143 (0.655)	0.087 (0.822)
Temperature	0.278 (0.236)	0.232 (0.321)	0.024 (0.695)
Sao2	-0.231 (0.322)	-0.094 (0.877)	-0.003 (0.654)
ABG parameters			
PH	0.525 (0.02) *	0.633 (0.004) *	0.455 (0.02) *
PCO2	0.237 (0.332)	0.239 (0.302)	0.199 (0.401)
PHCO3	0.408 (0.05)	0.505 (0.02) *	0.401 (0.07)
PO2	-0.143 (0.544)	-0.033 (0.644)	-0.233 (0.277)
SPO2	-0.095 (0.655)	-0.149 (0.433)	-0.049 (0.821)
Support parameters			
FIO2	0.519 (0.01) *	0.572 (0.008) *	0.567 (0.009) *
IPAP	-0.124 (0.643)	-0.073 (0.744)	-0.0.92 (0.701)
PEEP	0.313 (0.426)	0.338 (0.388)	0.335 (0.421)
HFNC Device			

Vital signs			
Respiratory rate	0.346 (0.433)	0.312(0.198)	0.077 (0.986)
Heart rate	0.189 (0.453)	0.022(0.766)	0.122 (0.753)
Blood pressure	-0.333 (0.213)	0.211(0.344)-	-0.233 (0.343)
Temperature	0.012 (0.765)	0.331(0.224)	0.322 (0.295)
Sao2	0.035 (0.677)	0.086(0.545)	0.298 (0.287)
ABG parameters			
PH	-0.249 (0.290)	-0.444 (0.334)	-0.352 (0.133)
PCO2	0.135 (0.565)	0.073 (0.655)	0.091 (0.732)
PHCO3	-0.051 (0.944)	-0.134 (0.445)	-0.151 (0.533)
PO2	0.743 (<0.001) *	0.618 (0.004) *	0.851 (<0.001) *
SPO2	0.112 (0.876)	0.046 (0.678)	0.239 (0.334)
Support parameters			
FIO2	0.632 (<0.001) *	0.677 (<0.001) *	0.578 (0.008) *
Temperature	----	----	----
Flow	0.322 (0.112)	0.140 (0.555)	0.277 (0.121)

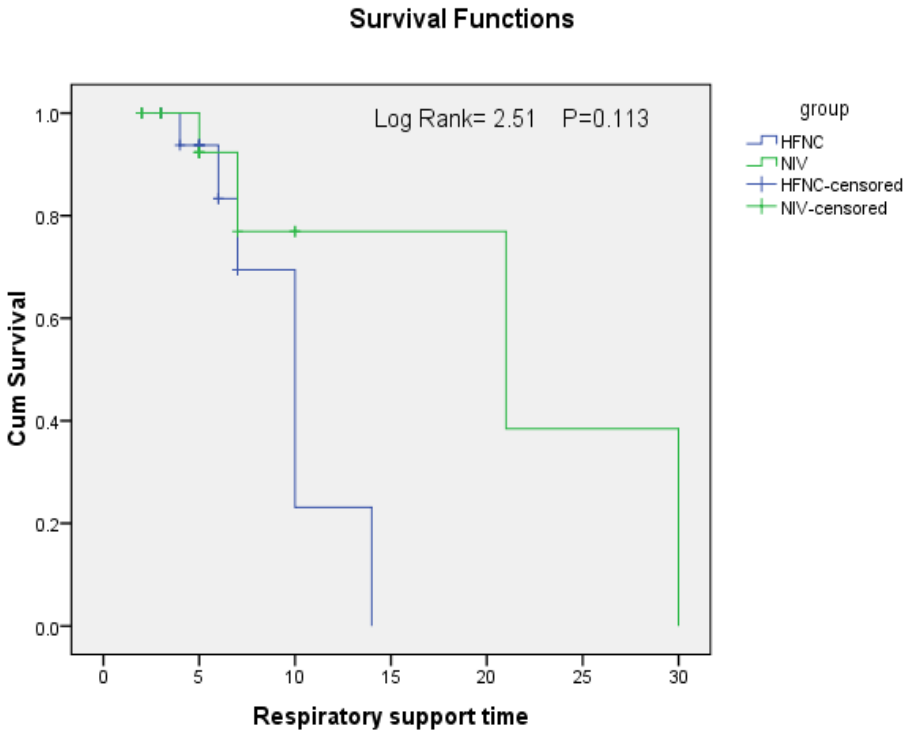

Figure 1: Cumulative failure rate regarding respiratory support time

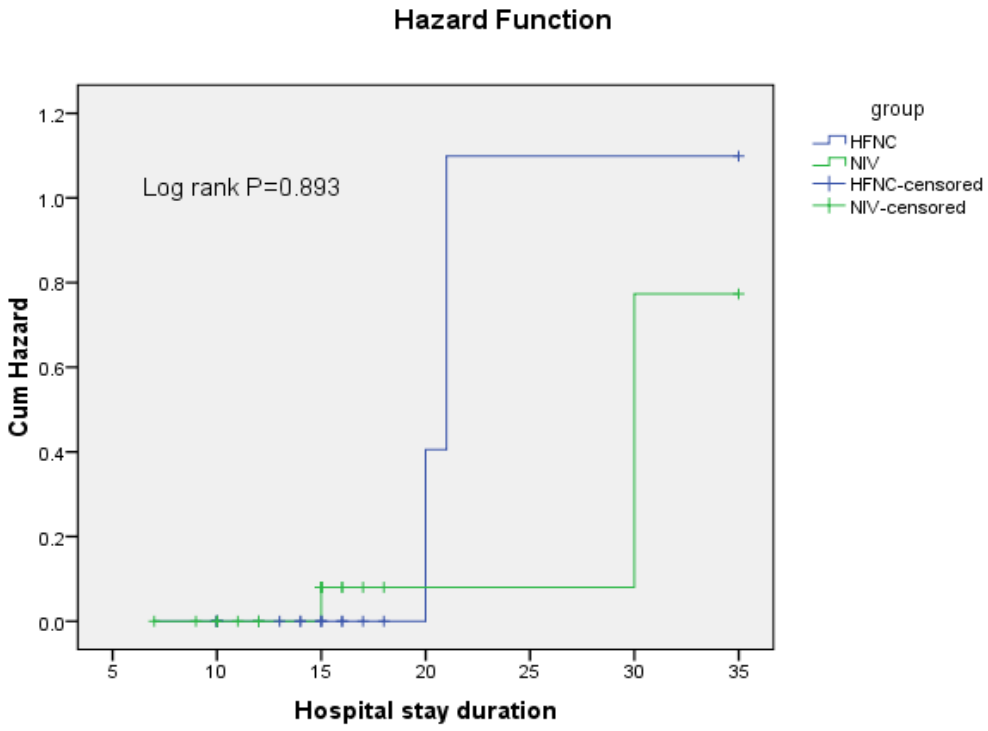

Figure 2: Cumulative failure rate regarding hospital stay time

Discussion

The current study was a prospective randomized controlled one that aimed to compare the efficacy of high flow nasal cannula versus non-invasive ventilation in the management patients with Hypercapnic acute exacerbation of COPD. It was conducted on40 patients who were randomly allocated into two equal groups**: Group A (observational group);** included 20 patients using HFNC. **Group B (control group);** included 20 patients using NIV low-flow O2.

The mean age of studied patients was 60.2 ±11.2 years; 77.5% of them were males while 22.5% were females, 35% were smokers, 42.5% were ex-smokers and 22.5% were nonsmokers. A similar observational trial was conducted **by Lee et al (14)** to evaluate the effectiveness of HFNC therapy in severe AECOPD with moderate hypercapnic acute respiratory failure (ARF) compared to NIV. They reported that the median age was 73 (66.5-79) years, 57 patients out of 92 (64.8%) were males. This was also true for **(15)** study where the mean age was 71.8±8.2 and (65.9%) of patients were males, **and McKinstry et al.,** study where mean age was 68 ±9.0 years and 11(45.8%) were females **(16).** Varmaghani et al in 2019 declared that

the prevalence of COPD had risen from 5.28% in the < 50 years group to 21.38% in the ≥ 60 years group. Prevalence of COPD was also higher among men. This difference could be due to the fact that smoking is more common among men **(17).** regarding smoking status, the lowest prevalence was detected in the never smoked group (7.20%) and the highest prevalence was in the current smokers (18.36%) **(17).** Studies imply that COPD is much more common among non-smokers than previously thought. 10% to 20% of people with COPD have never smoked. A recent large Canadian study showed that nonsmokers constitute almost 30% of those with COPD amidst Canadian residents **(18)**. The finding of COPD cases in never smokers means that, in addition to tobacco smoking, other factors like genetic susceptibility, diminished lung growth, respiratory infections and environmental exposures including occupational exposures and (outdoor and indoor) air pollution could lead to the development of COPD **(19).**

The mode of oxygen support used in the present study was NIV in 50% of studied cases with a mean oxygen support duration of 7.15 days, and HFNC in the other half with a mean oxygen support duration of 6.9 days. There was no significant difference between both groups regarding ABGs (PH, PaCO2, HCO3, and PaO2) assessed before starting therapy, after 12 hours of starting therapy, after 5 days of starting therapy, at end of therapy and on discharge. **(20)** who included 7 RCTs with a total of 481 patients in a meta-analysis to show the difference in clinical outcomes between HFNC with NIV in the AECOPD patients reported that there were no significant differences in of PaCO2, PaO2, and SpO2 between the HFNC group and the NIV group.

In a systemic review to evaluate the effect of HFNC compared to NIV and continuous oxygen therapy (COT) on intubation and mortality risks for AECOPD patients found that during respiratory distress; HFNC decreased the respiratory rate and diaphragm movement compared to COT. This results in decreasing alveolar ventilation and increasing PaCO2, indicating that HFNC decreased the respiratory effort and was beneficial for diaphragm recovery **(21)**.

In the current study, there was no significant difference in the outcome after therapy where 70% of those cases treated with HFNC improved versus 80% of cases exposed to NIV. In HFNC group, 6 patients had failed treatment (4 intubated and 2 died) while in NIV group, 4 patients failed treatment and had been intubated of whom 2 patients died and 2 patients improved on invasive mechanical ventilation. Fahey et al **(22),** in his meta-analysis, advocated HFNC over NIV for adjustment of PaCO2, pH, and PaO2, along with mortality rates and risk of intubation, although these findings were not statistically significant. Shifting to the opposite intervention was found to be higher among the HFNC group, despite again, this finding was not

statistically significant. Contrarily, Tan et al **(23)** preferred NIV over HFNC as they found treatment failure rates "translated as the rate of endotracheal intubation" higher in the HFNC group than in the NIV group. NIV was superior to HFNC in reducing PaCO2 at 48h after starting respiratory treatment. In Doshi et al (24) study failure rate was much higher in NIV group (29%) than HFNC group (4%) which was pertained to treatment intolerance. In Tan's et al study **(25)** treatment failure was found in 10 patients (22.7%) in the HFNC group and in 12 patients (28.6%) in the NIV group (risk difference, − 5.8%; 95% CI, − 23.8 to 12.4%. furthermore, Kaplan-Meier curves showed no statistical difference in cumulative failure rates between both groups (log-rank test 0.521, p = 0.470.

In the present study, no significant difference was found between both study groups regarding length of hospital or ICU stay, and duration of respiratory support. Huang et al **(26)** in his systematic review and meta-analysis, found no significant difference in the length of hospitalization between patients with HFNC and NIV, although there were differences in the duration of the ICU stay by 1day in favor of HFNC in 1 RCT but other RCTS showed no significant difference.

In the present study, there was a statistically significant higher number of patients who were comfortable during treatment with HFNC (75%) compared to NIV (40%), also prevalence of noisiness was significantly higher among NIV group 50% versus 10% of HFNC group. There was no significant difference between both groups regarding heaviness of nasal interface, dryness of nasal passage or ease of breathing**. Xu C et al (27)** declared that patients with hypercapnia can tolerate HFNC, and they felt more comfortable than NIV and COT, and that using HFNC caused a lower incidence of complications, compared with NIV. It has been identified that NIV needs a tight mask, which usually leads to discomfort for some patients and elevating the risk of treatment failure.

The current study reported no statistically significant correlation between (duration of hospital stay, support time & ICU admission time) &vital signs (systolic BP, diastolic BP, RR, pulse, temperature, and SaO2) or ABG of assessed patients using NIV or HFNC device, except for PH in NIV group and pO2 in HFNC group that were significantly correlated positively with all durations. **Jing et al (28)** found that HFNC is a possible alternative to NIV to wean hypercapnia COPD patients with respect to vital signs and ABGs, HFNC improved patients' comfort and secretion clearance.

Also, we found no statistically significant correlation between (duration of hospital stay, support time & ICU admission time) and NIV or HFNC device support parameters (FIO2, IPAP, and PEEP), except for FIO2 that was significantly correlated positively with

all durations. High Fio2 was used in more severe cases to improve oxygenation. Connors et al., describe the PaO2/FiO2 ratio as one of the mortality predictors in multivariate logistic regression analysis in AECOPD.**[29].** Prolonged high FiO2 exposure may be associated with worsening pulmonary function, in a dose response manner.[**30**]

Conclusion

In COPD patients with hypercapnic AECOPD, HFNC was non-inferior to NIV regarding ABG parameters during or after therapy, duration of support, ICU or hospital stay and outcome (including treatment failure and mortality). However, HFNC was better than NIV regarding patient comfort during therapy.

References

1. Agustí A, Celli BR, Criner GJ, Halpin D, Anzueto A, Barnes P, et al. Global Initiative for Chronic Obstructive Lung Disease 2023 Report: GOLD Executive Summary. Am J Respir Crit Care Med. 2023;207:819-37.

2. Dicker AJ, Huang JTJ, Lonergan M, Keir HR, Fong CJ, Tan B, et al. The sputum microbiome, airway inflammation, and mortality in chronic obstructive pulmonary disease. J Allergy Clin Immunol. 2021;147:158-67.

3. Hanson C, Bowser EK, Frankenfield DC, Piemonte TA. Chronic Obstructive Pulmonary Disease: A 2019 Evidence Analysis Center Evidence-Based Practice Guideline. J Acad Nutr Diet. 2021;121:139-65.e15.

4. Xu S, Ye Z, Ma J, Yuan T. The impact of chronic obstructive pulmonary disease on hospitalization and mortality in patients with heart failure. Eur J Clin Invest. 2021;51:e13402.

5. Hong H, Li XX, Li J, Zhang ZQ. High-flow nasal cannula versus nasal continuous positive airway pressure for respiratory support in preterm infants: a meta-analysis of randomized controlled trials. J Matern Fetal Neonatal Med. 2021;34:259-66.

6. Suffredini DA, Allison MG. A Rationale for Use of High Flow Nasal Cannula for Select Patients With Suspected or Confirmed Severe Acute Respiratory Syndrome Coronavirus-2 Infection. J Intensive Care Med. 2021;36:9-17.

7. Shah S, Kaul A, Bhosale R, Shiwarkar G. High Flow Nasal Cannula Therapy as a Primary Mode of Respiratory Support in a Pediatric Intensive Care Unit. Indian Pediatr. 2021;58:41-3.

8. Nishimura M. High-flow nasal cannula oxygen therapy in adults. J Intensive Care. 2015;3:15.

9. Criner G. Sorting Out the Mechanisms of Benefit of High Flow Nasal Cannula in Stable COPD. Chronic Obstr Pulm Dis. 2017;4:259-61.

10. Altman DG, Schulz KF. Statistics notes: Concealing treatment allocation in randomised trials. Bmj. 2001;323:446-7.

11. Schulz KF. Subverting randomization in controlled trials. Jama. 1995;274:1456-8.

12. Schulz KF, Grimes DA. Allocation concealment in randomised trials: defending against deciphering. Lancet. 2002;359:614-8.

13. Pilcher J, Eastlake L, Richards M, Power S, Cripps T, Bibby S, et al. Physiological

effects of titrated oxygen via nasal high-flow cannulae in COPD exacerbations: A randomized controlled cross-over trial. Respirology. 2017;22:1149-55.

14. Lee MK, Choi J, Park B, Kim B, Lee SJ, Kim SH, et al. High flow nasal cannulae oxygen therapy in acute-moderate hypercapnic respiratory failure. Clin Respir J. 2018;12:2046-56.

15. Sun J, Li Y, Ling B, Zhu Q, Hu Y, Tan D, et al. High flow nasal cannula oxygen therapy versus non-invasive ventilation for chronic obstructive pulmonary disease with acute-moderate hypercapnic respiratory failure: an observational cohort study. Int J Chron Obstruct Pulmon Dis. 2019;14:1229-37.

16. McKinstry S, Singer J, Baarsma JP, Weatherall M, Beasley R, Fingleton J. Nasal high-flow therapy compared with non-invasive ventilation in COPD patients with chronic respiratory failure: A randomized controlled cross-over trial. Respirology. 2019;24:1081-7.

17.Varmaghani, M., Dehghani, M., Heidari,E., Sharifi, F., Moghaddam ,SS., Farzadfar, F.,2019 Global prevalence of chronic obstructive pulmonary disease: systematic review and meta-analysis. East Mediterr Health J. 2019 Mar 19;25(1):47-57

18. Salvi SS, Barnes PJ. Chronic obstructive pulmonary disease in

non-smokers. Lancet. 2009;374:733–43.

19.Tan WC,Sin DD, Bourbeau J, Hernandez P, Chapman KR,Cowie R,et al Characteristics of COPD in never-smokers and ever-smokers in general population:results from the CanCOLD study.Thorax2015;70:822-829.

20. Du Y, Zhang H, Ma Z, Liu J, Wang Z, Lin M, et al. High-Flow Nasal Oxygen versus Noninvasive Ventilation in Acute Exacerbation of Chronic Obstructive Pulmonary Disease Patients: A Meta-Analysis of Randomized Controlled Trials. Canadian Respiratory Journal. 2023;2023:7707010.

21. Yang P-L, Yu J-Q, Chen H-B. High-flow nasal cannula for acute exacerbation of chronic obstructive pulmonary disease: A systematic review and meta-analysis. Heart & Lung. 2021;50:252-61.

22. Fahey AC, O'Connell M, Cornally N, Saab MM. High flow nasal cannula versus noninvasive ventilation in the treatment of acute hypercapnic respiratory failure: A systematic review and meta-analysis. Clin Respir J. 2023;17:1091-102.

23. Tan D, Wang B, Cao P, Wang Y, Sun J, Geng P, et al. High flow nasal cannula oxygen therapy versus non-invasive ventilation for acute exacerbations of chronic obstructive pulmonary disease with acute-moderate hypercapnic respiratory failure: a randomized controlled non-inferiority trial. Critical Care. 2024;28:250.

24. Doshi P, Whittle JS, Bublewicz M, Kearney J, Ashe T, Graham R, et al. High-velocity nasal insufflation in the treatment of respiratory failure: a randomized clinical trial. Ann Emerg Med.2018; 72:73–83 e75.

25. Tan D,Walline JH, Ling B, XuY, Sun J,Wang B, et al. High-flow nasal cannula oxygen therapy versus non-invasive ventilation for chronic obstructive pulmonary disease patients afterextubation: a multicenter, randomized controlled trial. *Crit Care*,24**,**489(2020).

26. Huang HW, Sun XM, Shi ZH, Chen GQ, Chen L, Friedrich JO, et al. Effect of High-Flow Nasal Cannula Oxygen Therapy Versus Conventional Oxygen Therapy and Noninvasive Ventilation on Reintubation Rate in Adult Patients After Extubation: A Systematic Review and Meta-Analysis of

Randomized Controlled Trials. J Intensive Care Med. 2018;33:609-23.

27. Xu C, Yang F, Wang Q, Gao W. Comparison of High Flow Nasal Therapy with Non-Invasive Ventilation and Conventional Oxygen Therapy for Acute Hypercapnic Respiratory Failure: A Meta-Analysis of Randomized Controlled Trials. Int J Chron Obstruct Pulmon Dis. 2023;18:955-73.

28. Jing G, Li J, Hao D, Wang T, Sun Y, Tian H, et al. Comparison of high flow nasal cannula with noninvasive ventilation in chronic obstructive pulmonary disease patients with hypercapnia in preventing postextubation respiratory failure: A pilot randomized controlled trial. Research in Nursing & Health. 2019;42:217-25.

29. connors AF, Dawson NV, Thomas C, Harrell FE, Desbiens N,Fulkerson WJ,et al., outcomes following acute exacerbation of severe chronic obstructive lung disease: the SUPPORT investigators(study to understand prognoses and preferences for outcomes and risks of treatment) . Am J Respir Crit Care Med 6; 154(4pt1):959-67

30. Sonal Rachmale, Guangxi Li, GregoryWilson, Michael Malinchoc, Ognjen Gajic. Respiratory Care Nov,2012,57,(11) 1887-1893

To cite this article: Amira H. Allam, Ahdaf A. Enan, Kholud M. Doyef , Abeer M. Rawy, Etemad A. Mohammed. High Flow Nasal Cannula versus Non -Invasive Ventilation in Hypercapnic acute exacerbation of COPD. BMFJ 2025;42(4):338-352.