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Efficacy & safety of awake prone positioning on high flow nasal oxygen HFNO/BIPAP in management of moderate COVID-19 ARDS in covid designated tertiary care hospital

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Abstract

Background: High flow nasal cannula oxygen (HFNO) is getting started to be used to deliver humidified oxygen in respiratory failure patients. In present study we assess HFNO compared to BIPAP in management of patients with ARDS following COVID-19.

Study type: Retrospective Randomised Comparative observational study.

Study place: LG hospital, AMCMET Medical College, Ahmedabad, Gujarat.

Study period: April 2021 to June 2021.

Methods: A retrospective analysis of 210 patients with COVID-19 and acute hypoxemic respiratory failure admitted to the intensive care unit (ICU), and treated by authors, 105 patients received HFNO as initial therapy, and 105 patients were primarily treated with BIPAP. There was no significant difference between the 2 groups in terms of baseline characteristics, laboratory tests, arterial blood gases, Haemodynamic parameters, PaO₂/FiO₂ values. Re-assessment after HFNO or BIPAP showed significant improvement ($P < 0.05$) in oxygenation parameters than baseline values.

Results: The magnitude of improvement of oxygenation was not significantly different between patients using HFNO or BIPAP.

Conclusion: Both HFNO/ BIPAP when used with awake proning can prevent endotracheal intubation in almost 90% of COVID-19 ARDS.

Keywords: ARDS, BIPAP, COVID-19, high flow nasal oxygen (HFNO)

Introduction

The Novel coronavirus that causes acute respiratory distress syndrome/Hypoxic ventilation failure that requires invasive mechanical ventilation and is with high mortality^[1, 2].

BIPAP has been widely used in acute hypoxemic respiratory failure secondary to different causes, and it proved to be beneficial in COVID-19 patients admitted to ICU^[3].

High flow nasal cannula oxygen (HFNO) is a relatively new technique used in the management of acute hypoxemic respiratory failure. It delivers heated humidified oxygen through nasal prongs at increasing high flow rates up to 60 liters/minute^[4].

Methods

In this retrospective observational study, we analyzed all the data of the patients given ventilatory treatment by authors, who were admitted to ICU of LG hospital, AMCMET Medical College Ahmedabad with confirmed COVID-19 associated with hypoxemic respiratory failure in the period between April 2021 to June 2021. Written Consent was obtained from the patients & relatives.

Inclusion criteria: Confirmed COVID-19 patients by real-time reverse transcription polymerase chain reaction (RT-PCR). All included patients had acute hypoxemic respiratory failure and received either HFNO or BIPAP as initial therapy as per standard WHO protocol.

Exclusion criteria: Patients who required invasive mechanical ventilation with endotracheal intubation on admission, or who did not use neither HFNO nor BIPAP as initial therapy. Patients were also excluded in case of missing data necessary for analysis.

Patients with no available consent to use their data for publication were also excluded. Awake prone positioning given to all patients in each group. The following data were retrieved from the patients' records: demographics, results of baseline laboratory and arterial blood gases tests, vital signs, and baseline PaO₂/FiO₂ before treatment with either HFNO or BIPAP. We had calculated sequential organ failure assessment (SOFA) score, and Acute Physiology and Chronic Health Evaluation II (APACHE II) score at the time of admission. Included patients used either HFNO or BIPAP as initial therapy. Whenever HFNO was used, the settings were adjusted according to guidelines [5]. The flow was set from 30–60 l/min according to the need of patient, and the temperature settings between 31 and 37 °C. The fraction of inspired oxygen (FiO₂) was adjusted to keep the peripheral blood oxygen saturation (SpO₂) above 93%. Close monitoring of the vital signs and arterial blood gases, and if the management with HFNO was not successful (persistent severe symptoms, mainly dyspnea, in addition to failure in maintaining the oxygenation at the desired levels), then BIPAP was started if no necessary urgent endotracheal intubation, and in case of no or poor response to BIPAP, respiratory support was escalated with urgent endotracheal intubation and invasive mechanical ventilation according to the standard guidelines [6, 7, 8]. BIPAP mask was selected of appropriate size in each patient. Initial inspiratory pressure was set between 8 and 10 cm H₂O, and positive end expiratory pressure set at 4 cm H₂O; those pressures were gradually increased and continuously adjusted according to the clinical response. The fraction of inspired oxygen (FiO₂)

was set and titrated based on the SpO₂ aiming to maintain it more than 93%. In case of no response (persistent severe symptoms, mainly dyspnea, in addition to failure in maintaining the oxygenation at the desired levels), or intolerance to BIPAP, we used HFNO as a rescue if the condition did not necessitate urgent endotracheal intubation [6]. When the monitored clinical & lab parameters showed signs of improvement, we applied intermittent use of either HFNO or BIPAP, with weaning by Nonbreathing mask, venturimask & nasal prongs & lastly Room air. We have also monitored haemodynamic & blood gas monitoring through out hospital stay. When no improvement in clinical & lab parameters with sustain fall in PaO₂/FiO₂ ratio, (type I/II respiratory failure) plan endotracheal intubation was done as rescue procedure as institution protocol. It was notified. Records of endotracheal intubation, mortality & total time of HFNO and BIPAP was notified.

Statistical analysis

Data was retrieved & put on MS Excel spreadsheet. SPSS version 20.0 for Windows (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Test results are reported as mean and standard deviations (SD) for normally distributed continuous variables. A chi-square test was performed for categorical variables. An independent sample t test was conducted for parametric data. P values of <0.05 were considered statistically significant.

Results

Table 1: Patients characteristics

Characteristics	HFNO (n=105)	BIPAP (n=105)	P value	Inference
Age (yrs)	48+/-16	50+/-12	0.306	NS
Gender(M/F)	63/42	65/40	0.724	NS
DM/HT/IHD/COPD	70/15/8/6	72/14/9/5	-	-
APACHE II Score	9.6+/-3.8	9.5+/-2.7	0.826	NS
SOFA Score	2.8+/-0.2	2.8+/-0.4	1.0	NS

Table I showed patient characteristics at time of admission in hospital.
APACHE-II Score---Acute Physiology& Clinical Health

Evaluation II score
SOFA Score---Sequential Organ Failure Assessment score.

Table 2: Laboratory parameters

Parameters	HFNO (n=105)	BIPAP (n=105)	P value	Inference
CRP(mg/L)	65+/-12	64+/-12	0.54	NS
Ddimer (ngFEU/ml)	1000+/-10	1000+/-8	0.5	NS
NLR	3.8+/-1.2	3.6+/-1.4	0.26	NS
S.Creatinine (mg/dl)	0.8+/-0.2	0.8+/-0.3	1.00	NS
Blood Urea Nitrogen (mg/ dl)	18+/-12	18+/-11	1.00	NS
Procalcitonin (ng/ml)	0.06+/-0.01	0.06+/-0.0	1.00	NS
S.Na	134+/-2	134+/-6	1.00	NS
S.K	3.8+/-0.4	3.8+/-0.3	1.00	NS

Table II showed lab investigation in each group.

Table 3: Haemodynamic & Arterial Blood gas monitoring (Baseline)

Parameters	HFNO	BIPAP	P value	Inference
Heart rate	72+/-12	74+/-10	0.19	NS
Respiratory rate	22+/-3	22+/-6	0.08	NS
MeanBP(mmofHg)	86+/-4	84+/-6	1.00	NS
PH	7.38+/-0.2	7.34+/-0.6	0.74	NS
Paco ₂	34+/-10	32+/-12	0.19	NS
PaO ₂ /FiO ₂	166+/-12	168+/-10	0.19	NS

Table 4: Haemodynamic & Arterial Blood gas monitoring (After HFNO/ BIPAP & prone positioning)

Parameters	HFNO(n=105)	BIPAP(n=105)	P value	Inference
Heart rate	78+/-10	76+/-12	0.19	NS
Respiratory rate	21+/-3	22+/-4	1.00	NS
Mean BP	88+/-6	87+/-8	0.30	NS
PH	7.36+/-0.5	7.35+/-0.6	0.70	NS
PaCO ₂	36+/-6	36+/- 5	1.00	NS
PaO ₂ /FiO ₂	224+/-18	222+/-16	0.38	NS

Table III and IV showed haemodynamic & blood gas monitoring baseline & after application of HFNO/BIPAP

which showed improve PaO₂/FiO₂ ratio of almost 60 after treatment in both groups.

Table 5: Intubation and Mortality Rates & Mean ICU stay.

Rate	HFNO(n=105)	BIPAP(n=105)	P value	Inference
Endotracheal intubation Rate	11(10.8%)	12(11.5%)	0.9	NS
Mortality Rate	2(2.1%)	2(2.1%)	1.00	NS
Mean ICU stay (days)	5.53+/-1.11	5.86+/-1.10	0.07	NS

Discussion

COVID-19 pandemic cause moderate to severe form of ARDS & Type I & II ventilation failure. Aim of our study was to assess HFNO/ BIPAP along with awake prone positioning for treatment of Hypoxemia ventilation failure. Various oxygenation & ventilation strategy were declared periodically during pandemic & various studies done worldwide to improve health care facilities [1, 2, 3].

We have used awake proning as it improve oxygenation in covid ARDS.

Koeckerling D. *et al.* showed advantages of awake proning in COVID-19 patients [4].

Ding *et al.* suggested that early awake proning with HFNO/ BIPAP can prevent ventilation assisted Lung Injury (VALI), decrease Ventilation perfusion(V/Q) mismatch, decrease intrapulmonary shunt, improve PaO₂/FiO₂ ratio and prevent intubation in patients of moderate ARDS [5].

All patients in each group had comparable haemodynamic parameters & PaO₂/FiO₂ ratio improve than baseline in both HFNO/ BIPAP groups. PaCO₂ was not increase whereas Respiratory rate was also not increase. (TABLE III & IV). It is due to combination of awake proning with HFNO /BIPAP, so that easy removal of mucus plugs& decrease in work of breathing [4, 5].

The role of humidified high flow nasal oxygen in the management of hypoxemia associated with respiratory distress is described in previous studies [9, 10].

Regarding intubation rate, mortality rate & days of treatment both groups were comparable (Table V) $P > 0.05$.

The mean duration of treatment with HFNO in our study was 5.53±1.11 days, while the duration of treatment with BIPAP was 5.86±1.10 days.

The average rates of endotracheal intubation with invasive mechanical ventilation for patients who received HFNO and BIPAP were 10.8% and 11.5%, whereas mortality in both groups was 2%.

Our results are in accordance with the results of another study [11] which showed an average rate of endotracheal intubation for COVID-19 patients treated with HFNO of 17%, and 15% for those treated with BIPAP; the average duration of therapy in this study [11] was 5.1 days for HFNO and 6.8 days for NIV [11]. In meta-analyses of Monro-Somerville T, & Maitra S. [12, 13] of HFNO in hypoxemic respiratory failure patients found no added benefit to usual treatment, while another recent meta-analysis [14] found a beneficial effect of HFNO with significant reduction of the

rate of endotracheal intubation, and the benefits were comparable to NIV in terms of outcome and mortality rate [14].

In our study, HFNO proved to be successful in managing patients with COVID-19 and acute hypoxemic respiratory failure; the rate of failure and the need to escalate the respiratory support was very low. Comparing the results of HFNO with BIPAP there was no statistical significant difference in terms of outcomes.

It has been proved that whenever intubation is indicated in patients with acute respiratory failure, it should not be delayed [15, 16].

Our choice of either HFNO or BIPAP was based on the primary clinical assessment, and this did not delay endotracheal intubation and invasive mechanical ventilation for patients who required such intervention. Also, close monitoring to our patients allowed us to intervene at the right time. In the present study, the vital signs and PaO₂/FiO₂ showed significant improvement 24h following initiation of either HFNO or BIPAP there was no significant difference in the magnitude of improvement between both groups, those findings are in accordance with the findings reported in study of Zaho, comparing HFNO to BIPAP in HRF patients [14], & they also reported similar improvement in patients receiving either mode of NIV, with no difference in the rate of endotracheal intubation or mortality rate. A previous study has evaluated alternating HFNO with BIPAP in patients HRF, and they found a beneficial effects of HFNO given in between the sessions of NIV; it helped to avoid major drops in oxygenation levels [17].

It has been previously demonstrated that NIV can improve gas exchange, decrease the rate of endotracheal intubation, and reduce the mortality in patients with respiratory failure [18].

Compared with BIPAP, HFNO may have some advantages, such as greater patient comfort, easier clearance of secretions, and lower costs [17], in addition to lower incidence of different adverse events that may lead to poorer outcomes [19]. Both HFNO and BIPAP are aerosol generating procedures. Theoretically, BIPAP generates more aerosols than HFNO because it generates higher pressures [20]. The transmission of infection is always a major concern when dealing with COVID-19 patients. In our study, there was no transmission of infection to any of our ICU staff.

Limitations

- We have not done cases with out awake proning as we want to give advantages of awake proning to each patient.
- Study is Retrospective in nature.

Conclusion

In nutshell Efficacy of, High flow nasal cannula oxygen (HFNO) is similar to BIPAP when used with awake proning for non invasive ventilation and oxygenation in the management of COVID-19 moderate ARDS with no difference in the duration of treatment, endotracheal intubation rate, mortality rate.

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