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Use of noninvasive ventilator-BIPAP versus facemask in chronic obstructive pulmonary disease patients admitted to emergency ward with type ii respiratory failure: A prospective comparative study

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Abstract
Objective: Use of NIV (BIPAP) versus Facemask in COPD patients admitted to emergency ward with type -2 respiratory failure. This study in regards to arterial blood gas analysis, requirement of intubation and hemodynamic parameters.
Materials and methods-study design: Prospective randomised study; This study was conducted after obtaining ethical committee permission. Patients participating in study were explained in their native language about study and written consent was obtained 50 patients in the age groups of less than 80 years with ASA -2 and 3, were divided in to two groups. Group NIV were ventilated with BIPAP with pressure setting adequate to deliver tidal volume of 6-8 ml and Fio2 of 40%.Group FM were ventilated with simple Facemask with 5 liters of o2 per minutes, other pharmacological treatments were continued in both groups similarly. Qualitative test analyzed with chi square test and Quantitative test analyzed with student t test, p value <0.05 is considered statistically significant in all the above test.
Results: In NIV patients, pH-3.8+- 0.04, pao2-84.5+-10.37 and in FM pH -7.29+-0.06,pao2-68.8+ -13.34 at 1 hour after. P value is <0.05
Conclusion: NIV is beneficial in COPD patients with type 2 respiratory failure compared to traditional face mask and improve the outcome.

Keywords: BIPAP, Facemask, ABG, hemodynamics

1. Introduction

- Chronic Obstructive Pulmonary Disease (COPD) is a chronic disease of airway and lung parenchyma which is characterized by deficient airflow through lungs and incorporates chronic bronchitis and emphysema.
- Acute exacerbations causes Type II respiratory failure which is characterized by hypoxia and hypercarbia [2].
- Present study compares the efficacy of ventilation through Face Mask (FM) and Bilevel Positive Airway Pressure (BiPAP) to treat type II respiratory failure [1].
- Noninvasive Ventilator (NIV) refers to delivery of ventilatory support to lungs without an invasive endotracheal airway [3].
- It needs a special type of mask which fits tightly around the nose and mouth
- It avoids the complications associated with endotracheal intubations and mechanical ventilation.
- Simple face mask is a plastic reservoir designed to fit over patient nose and mouth
- It is simple, quick and easy to set up and apply.

Review of Literature

Pandey R etal. Katamandu Conduncted Retrospective analysis of data of 28 patients in between June 2010-November 2010 was done. All the patients selected had respiratory failure. Records were analysed for documentation of clinical diagnosis. Arterial blood gases were assessed prior to, after starting and after discontinuation of NIV. The outcome of NIV and the need for domiciliary oxygen was evaluated at discharge.

Thirty four patients received NIV out of which 6 were excluded from the study due to insufficient documentation. Out of these 28 patients, 27 received bi-level and one patient received Continuous Positive Airway Pressure. Mean age of patients was 66.5 years and ranged from 42-87 years. Majority (19, 79%) were from age group 60-80 years.

Most common cause for the use of bi-level ventilation was chronic obstructive pulmonary disease with type 2 respiratory failure in 19 patients (67.8%). Others included obesity hypoventilation syndrome two, acute interstitial pneumonia two, cardiogenic pulmonary oedema two, interstitial lung disease one, bronchogenic carcinoma one, and bronchiectasis one. Arterial blood gas analysis was done on admission and 12 hours or earlier after the onset of bi-level ventilation.

At the time of admission, 89.3% of the patients had type 2 respiratory failure, of which 60.6% had respiratory acidosis and 67.9% of patients had pCO2 above 60 mm Hg. Arterial blood pH prior to admission ranged from 7.19 to 7.50. Twelve hours after bi-level ventilation, only 21.3% had pH <7.35 and 42.8% had pCO2 above 60 mm Hg. Noninvasive ventilation was successful in 27 patients (96.4%). All patients were advised domiciliary oxygen and all patients had respiratory follow up arranged.

COPD patients with type 2 respiratory failure were seen to benefit most with NIV. It is a very cost effective and safe method of treatment and should be used first in patients with COPD with type 2 respiratory failure.

Brochard, L *et al*. Conducted Study on the short-term (45-minute) physiologic effects of the apparatus in 11 patients with acute exacerbations of chronic obstructive pulmonary disease and evaluated its therapeutic efficacy in 13 such patients (including 3 of the 11 in the physiologic study) who

were treated for several days and compared with 13 matched historical-control patients

In the physiologic study, after 45 minutes of inspiratory positive airway pressure by face mask, the mean (+/- SD) arterial pH rose from 7.31 +/- 0.08 to 7.38 +/- 0.07 (P less than 0.01), the partial pressure of carbon dioxide fell from 68 +/- 17 mm Hg to 55 +/- 15 mm Hg (P less than 0.01), and the partial pressure of oxygen rose from 52 +/- 12 mm Hg to 69 +/- 16 mm Hg (P less than 0.05).

These changes were accompanied by marked reductions in respiratory rate (from 31 +/- 7 to 21 +/- 9 breaths per minute, P less than 0.01). Only 1 of the 13 patients treated with inspiratory positive airway pressure needed tracheal intubation and mechanical ventilation, as compared with 11 of the 13 historical controls (P less than 0.001). Two patients in each group died.

As compared with the controls, the treated patients had a more transient need for ventilatory assistance (3 +/- 1 vs. 12 +/- 11 days, P less than 0.01) and a shorter stay in the intensive care unit (7 +/- 3 vs. 19 +/- 13 days, P less than 0.01).

This Study Concluded that positive airway pressure delivered by a face mask can obviate the need for conventional mechanical ventilation in patients with acute exacerbations of chronic obstructive pulmonary disease.

Plant J al conducted study on early use of non-invasive ventilation for acute exacerbations of chronic obstructive pulmonary disease on general respiratory wards: A patient admitted for COPD exacerbation arrives to the floor having received corticosteroids, antibiotics, and frequent nebulizer treatments in the ED and he still looks dyspneic; what are your options? This RCT found that adding pressure support ventilation (i.e. BiPAP) to standard therapy in hypercapneic and mild/moderately acidemic (pH 7.25-7.35) patients with COPD exacerbation significantly reduced need for intubation and in-hospital mortality.

The study protocol set the initial inpiratory/expiratory pressure at 10/4 cm H2O and increased as tolerated, and patients were initially maintained on the mask for as long as tolerated on day 1. The amount of time on pressure support ventilation was gradually weaned over next 3 days. The exclusion criteria for this study included patients who were severely acidemic (pH <7.25) and those with poor mental status (GCS<8) because an adequate central respiratory drive is required for pressure support ventilation

And they concluded the early use of NIV for mildly and moderately acidotic patients with COPD in the general ward setting leads to more rapid improvement of physiological variables, a reduction in the need for invasive mechanical ventilation (with objective criteria), and a reduction in in-hospital mortality.

Objectives

To compare the efficacy of NIV versus Face mask in terms of

1. Improvement in arterial blood gas
2. Requirement of intubation
3. Hemodynamic parameters

Methodology

- Institutional ethical committee permission taken
- Consent from all patients taken after explaining the purpose of the study
- Duration: Oct 2018- June 2019
- Sample size: 50 patients
- Subjects: COPD patients presenting to emergency room with type II respiratory failure

Inclusion criteria

- Age < 80 years
- ASA 2 and 3
- Type 2 respiratory failure diagnosed by ABG
- Conscious and alert at the time of admission

Exclusion criteria

- Ph <7.00
- PCO2 >75
- PO2 <35
- Multiple co morbidities
- Drowsy, disoriented patients.
- After explaining the patients and obtaining consent for the study, 50 patients are divide into two groups of 25 each.
- Group NIV are ventilate with BiPAP with pressure settings adequate to deliver tidal volume of 6-8ml and FiO2 of 40%
- Group FM are ventilate with simple face mask with 5 liters of Oxygen per minute
- Other pharmacological treatments are continue in both groups similarly

Criteria to consider as Failure (and intubate)

- Worsening of ABG
- Tachypnea >40/min
- SPO2 < 85%
- Heart rate >140/min
- Clinically worsening features.
- These patients are immediately intubate and ventilate mechanically in ICU

Parameters measured

- Age, Sex, Duration of COPD
- ABG at admission, at first hour and 6th hour.
- Hemodynamic parameters
- Respiratory rate
- Failure rates
- Duration of ICU stay

Statistics

- Qualitative observations viz Sex and outcome were analysed with Chi Square test
- Quantitative tests viz duration of COPD, weight, Ph, PaO2, PaCO2, Failure rates, duration of hospital stay were analysed with Student t test
- P value less than 0.05 is considered statistically significant in all the above tests

Results

Demographical data

Table 1

Parameters	Facemask	BiPAP	P Value
Age	68.8 ±8.48	70.2±7.82	>0.05
Sex (M:F)	20:5	19:6	>0.05
Weight	54.25±6.48	55.1±5.83	>0.05
Duration of COPD	10.4±2.6	9.6±2.9	>0.05

- Both groups are comparable in terms of age, wieght and duration of the disease

Results

ABG changes during the course of treatment

Table 2

Parameters		Face mask group	BiPAP group	P value
Base line ABG	P^H	7.16±0.18	7.14±0.16	>0.05
	PaO_2	51.3±15.2	48.6±18.4	>0.05
	CO_2	58.2±14.04	60.4±11.4	>0.05
ABG at 1 hour	P^H	7.29±0.06	7.38±0.04	<0.05
	PaO_2	68.8±13.34	84.5±10.37	<0.05
	CO_2	50.1±16.17	40.1±5.08	<0.05
ABG at 6 hour	P^H	7.32±0.14	7.39±0.03	<0.05
	PaO_2	79.2±11.43	92.7±9.43	<0.05
	CO_2	49±14.36	38.4±6.74	<0.05
Failures		16	5	<0.05
Duration of hospital stay		6.4±0.82	4.9±0.43	<0.05

Discussion

- NIV is a useful method of ventilation in respiratory failure due to COPD, OSA, OHS and some cases of asthma.
- It improves the blood gas parameters and avoids many complications of invasive ventilation
- In our study, the 2 groups were comparable demographically and as per the duration of the disease.
- NIV showed better improvement in ABG values during the treatment compared to face mask ventilation
- Hemodynamic parameters were significantly stable in NIV group of patients
- Failure rates and duration of hospital stay were less in NIV group of patients
- Among failures, 4 patients from face mask and 3 patients from NIV group expired

Conclusion

- NIV (BiPAP) is beneficial in stable, conscious COPD patients with type II respiratory failure compared to traditional face mask and improves the outcome.
- However for hemodynamically unstable, unconscious, disoriented and patients with less breathing efforts, definitive airway with ET tube and mechanical ventilation is helpful.

Proforma

Sl. Number:
Name: Age/Gender: IP Number:
Ward: Date of surgery: ASA Physical status:
Weight: Height: Comorbids:

Table 3

Parameters	Facemask	BiPAP	P Value
Age			
Sex (M:F)			
Weight			
Duration of COPD			

ABG changes during the course of treatment

Table 4

Parameters		Face mask group	BiPAP group	P value
Base line ABG	P^H			
	PaO_2			
	CO_2			
ABG at 1 hour	P^H			
	PaO_2			
	CO_2			
ABG at 6 hour	P^H			
	PaO_2			
	CO_2			
Failures				
Duration of hospital stay				

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