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ROLE OF NON INVASIVE VENTILATION IN THE MANAGEMENT OF TYPE 2 RESPIRATORY FAILURE

Pulmonary Medicine

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ABSTRACT

INTRODUCTION Chronic Obstructive Pulmonary Disease (COPD) is a common preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases. Patients with COPD are also prone to exacerbations with progression of their disease, which often lead to hypercapnic respiratory failure.

MATERIAL AND METHODS A study was conducted from august 2017 To November 2018 in kamla Nehru chest hospital, Department of pulmonary medicine, Dr.SN. Medical College Jodhpur, a tertiary care centre for respiratory diseases in western part of Rajasthan, India. This will be a prospective observational study evaluate Role of NonInvasive ventilation in the management of Type 2 Respiratory failure.

RESULT In this study 80 patients of a total of 110 had successful outcome giving a success rate of 72.72% for NIV, 30 patients (27.27%) had unfavourable outcome. Mean age of the population was 60.6+8.6 years. Maximum number of patients were in the age group of 60-69 years in both males and females. success rate of NIV was highest in the age group <50 years (100% success). success rate of NIV was slightly higher in males (77.27%) as compared to females subjects (22.73%).

CONCLUSION effective use of niv results in fewer complicaitons, shorter length of hospital stay, and lower mortality. the need for mechanical ventilation is also reduced. in a low resource setting as we find in our country, admission practices towards and icu is usually made arbitrarily. NIV is a cost effective intervention in acute exacerbation of COPD with hypercapnic respiratory failure.

KEYWORDS

COPD, NONINVASIVE VENTILATION

INTRODUCTION Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases.[1] No drug treatment has been shown to affect the natural history of COPD. Long-term oxygen therapy (LTOT) is the only treatment known to improve the survival in patients with severe respiratory failure due to COPD.[2]Usually, the progression of COPD is gradual, although the disease often presents exacerbations of respiratory symptoms requiring hospitalization. This leads to greater use of medical resources and increases direct and indirect costs.[3,4] Clinicians have long been frustrated by their inability to substantially improve the condition of patients with severe COPD and are discouraged by the marginal response to standard pharmacotherapeutic agents. Patients with COPD are also prone to exacerbations with progression of their disease, which often lead to hypercapnic respiratory failure. Tracheal intubation and mechanical ventilation has so far been the standard therapy for such patients. The frequency of assisted ventilation in hypercapnic respiratory failure varies from 16-35% with a significant overall mortality[5].Tracheal intubation and mechanical ventilation is associated with a number of complications.[6]A major problem is the prolonged duration of ventilation and difficult weaning from ventilation necessitating prolonged stay in intensive care units. Non invasive ventilation refers to the technique of augmenting alveolar ventilation without a direct conduit to the airway. Such techniques were used earlier during the polio epidemics of the last century but gradually fell into disuse. Non-invasive ventilation (NIV) in the management of acute type II respiratory failure in patients with chronic obstructive pulmonary disease (COPD) represents one of the major technical advances in respiratory care over the last decade. The National Institute for Health and Clinical Excellence (NICE) recommend the NIV be available in all hospitals admitting patients with COPD.[7]

MATERIALAND METHODS

Study Design

The study will be conducted in Kamla Nehru chest hospital, DR S N Medical College Jodhpur, a tertiary care center for respiratory diseases in western part of Rajasthan, India. This will be a prospective observational study evaluate Role of NonInvasive ventilation in the management of Type 2 Respiratory failure.

Sample Size

Sample size was calculated at 95% confidence level, 0.05 alpha error, assuming 78% success of Non Invasive Mechanical Ventilation in COPD with acute respiratory failure, at 10% of relative allowable error. 110 COPD cases with acute hypercapnic respiratory failure were included in the present study.

SOURCE OF DATA

In patients getting admitted to Kamla Nehru Chest Hospital with features of acute respiratory failure. Duration of study Period:15 months or whenever sample size achieved Adult patients admitted to Kamla Nehru Chest Hospital in the Emergency department and ICU will be included in this study.

CRITERIA OF INCLUSION IN THE STUDY

- Age above 18 years.
- Ph<7.35 and PaCO2>45mmHg, PaO2<60mmHg, SpO2<92% with oxygen by mask.
- Primary diagnosis of COPD exacerbation.
- Conscious cooperative patient.
- Able to maintain the airway.
- Those giving informed consent.
- Hemodynamically stable.

CRITERIA OF EXCLUSION IN THE STUDY

- Patients with Confusion/agitation/Severe cognitive impairment
- pH<7.2

- Recent facial or upper airway surgeries
- Facial burns/trauma
- Hemodynamic instability
- Inability to protect the airway
- Un co-operative patients
- Severe co-morbidity

OBSERVATION

Table 1: Age and sex distribution of study subjects

Age (yrs)	Male		Female		Total	
	N	%	N	%	N	%
38-50	9	10.23	3	13.64	12	10.91
51-60	22	25.00	8	36.36	30	27.27
61-70	46	52.27	10	45.45	56	50.91
71-80	11	12.50	1	4.55	12	10.91
Total	88	100.00	22	100.00	110	100.00

Table 2: Distribution of study subjects according to initial pH

pH at start	Male		Female		Total	
	N	%	N	%	N	%
7.21-7.25	19	21.59	5	22.73	24	21.82
7.26-7.30	45	51.14	11	50.00	56	50.91
7.31-7.35	24	27.27	6	27.27	30	27.27
Total	88	100.00	22	100.00	110	100.00

Table 3: Distribution of study subjects according to initial pCO2

Initial pCO2 (mmHg)	Male		Female		Total	
	N	%	N	%	N	%
≤60	13	14.77	3	13.64	16	14.55
61-70	36	40.91	9	40.91	45	40.91
71-80	23	26.14	4	18.18	27	24.55
>80	16	18.18	6	27.27	22	20.00
Total	88	100.00	22	100.00	110	100.00

Table 4: Distribution of study subjects according to outcome of NIV

Outcome of NIV	No. of patients	Percentage
Success	80	72.73
Failure	30	27.27
Total	110	100.00

Table 5: Outcome of NIV in relation to age group of study subjects

Age (yrs)	Success		Failure		Total	
	N	%	N	%	N	%
38-50	12	100.00	0	0.00	12	100.00
51-60	24	80.00	6	20.00	30	100.00
61-70	38	67.86	18	32.14	56	100.00
71-80	6	50.00	6	50.00	12	100.00
Total	80	72.73	30	27.27	110	100.00

Table 6: Outcome of NIV in relation to sex of study subjects

Sex	Success		Failure		Total	
	N	%	N	%	N	%
Male	68	77.27	20	22.73	88	100.00
Female	12	54.55	10	45.45	22	100.00
Total	80	72.73	30	27.27	110	100.00

Table 7: Outcome of NIV in relation to initial pH

pH at start	Success		Failure		Total	
	N	%	N	%	N	%
7.21-7.25	8	33.33	16	66.67	24	100.00
7.26-7.30	46	82.14	10	17.86	56	100.00
7.31-7.35	26	86.67	4	13.33	30	100.00
Total	80	72.73	30	27.27	110	100.00

Table 8: Outcome of NIV in relation to initial pCO2

pCO2 at start	Success		Failure		Total	
	N	%	N	%	N	%
≤60	16	100.00	0	0.00	16	100.00
61-70	36	80.00	9	20.00	45	100.00
71-80	20	74.07	7	25.93	27	100.00
>80	8	36.36	14	63.64	22	100.00
Total	80	72.73	30	27.27	110	100.00

Table 9: Time trend of pH in success and failure outcome patients

ABG (time)	Success (Mean±SD)	Failure (Mean±SD)
At start	7.29±0.03	7.26±0.04
At 1 hour	7.30±0.02	7.24±0.03
At 3 hours	7.33±0.02	7.19±0.05
F & P value	56.81, <0.0001	10.64, 0.0001

RESULT

A total 110 patients were included in the present study with 88 males and 22 females. Mean age of the population was 60.6±8.6 years. Maximum number of patients were in the age group of 60-69 years in both males and females. The overall success rate of NIV in this study was 72.73%.

In the present study, success rate of NIV was highest in the age group <50 years (100% success). It was subsequently decreasing in higher age group with lowest success rate >70 years age group (62.5%). However, this difference was not found to be statistically significant (P= 0.177) i.e. outcome of NIV was not found to be associated with age.

In the present study, success rate of NIV was slightly higher in males (77.27%) as compared to females subjects (22.73%).

In the present study we took patients with initial pH range of 7.21-7.35. These patients were divided into three groups of pH, 7.21-25, 7.26-7.30 and 7.31-7.35. Mean pH of the patients were 7.28±0.036. Success rate of NIV was significantly better in patients with pH between 7.26-7.30 (86.6%) and pH 7.31 -7.35 (85.7%) as compared to those with severe acidosis pH 7.21 – 7.25 (40.7%). This difference was found to be statistically significant (P<0.001).

In the present study, we took patients with $PaCO_2$>50 mm Hg. Patients were divided in four groups on basis of initial $PaCO_2$. The success rate of NIV was highest in patients with pCO_2 <60 mm Hg (100%) and gradually decreases as pCO2 increases with lowest being for those with pCO2 >80mm Hg (36%).

This difference was found to be statistically significant (P<0.05); i.e. the outcome of NIV was found to be significantly associated with initial pCO2.

DISCUSSION

The present study was conducted from September 2017 to August 2018 in Kamla Nehru Chest Hospital, Dept of Pulmonary Medicine, Dr. S.N. Medical College, Jodhpur With an aim to study **"Role of Non Invasive ventilation in the management of Type 2 Respiratory failure"** This was a prospective type of observational study.

A total 110 patients were included in the present study with 88 males and 22 females. Mean age of the population was 60.6±8.6 years. Maximum number of patients were in the age group of 60-69 years in both males and females. In a previous study which was conducted by Ritesh Aggrawal et al[8] in PGI Chandigarh, 24 patients of COPD with acute respiratory failure were taken with a mean age of 56±11.8years with 37.5% female population. Another study at AIIMS by GC Khilnaniet et al,[9] reported a mean age of 55.25±10.09 year and 60±10.07 years in NIV and control group. A total of 40 patients were included in the study with 22.5% females.

The overall success rate of NIV in this study was 72.73%. A similar study by Khilnani GC et al[9] had shown success rate of 85% on patients with mean $PaCO_2$ 85.4 mm Hg and mean pH 7.23 at beginning of the study. McLaughln KM et al[10] reported a success rate of 72% in pH≥7.25. In the present study, the mean initial $PaCO_2$ was71.90±10.89 mm Hg and pH was 7.28±0.04.

In the present study, success rate of NIV was highest in the age group <50 years (100% success). It was subsequently decreasing in higher age group with lowest success rate >70 years' age group (62.5%). However, this difference was not found to be statistically significant (P= 0.177) i.e. outcome of NIV was not found to be associated with age.

In the present study, success rate of NIV was slightly higher in males (77.27%) as compared to females subjects (22.73%).

The physiologic changes of COPD affect women and men differently in terms of symptoms and quality of life. In the Confronting COPD International Survey, women were more likely to report severe dyspnea despite significantly fewer pack-years of smoking. Despite these facts, most of the studies have found no effect of gender on NIV success.

In the present study we took patients with initial pH range of 7.21-7.35. These patients were divided into three groups of pH, 7.21-25, 7.26-7.30 and 7.31-7.35. Mean pH of the patients were 7.28±0.036. Success rate of NIV was significantly better in patients with pH between 7.26-7.30 (86.6%) and pH 7.31 -7.35 (85.7%) as compared to those with severe acidosis pH 7.21 – 7.25 (40.7%). This difference was found to be statistically significant (P<0.001).

Ambrosino et al[11] also found that patients in whom NIV treatment failed, were significantly more acedemic at baseline than those who were successfully treated (pH 7.22±0.08 versus 7.28±0.04, p<0.005). Similarly, Brochard et al[12] using criteria for the need for intubation, found that success was less likely with a lower starting pH.

In the present study, we took patients with $PaCO_2$>50 mm Hg. Patients were divided in four groups on basis of initial $PaCO_2$. The success rate of NIV was highest in patients with pCO_2 <60 mm Hg (100%) and gradually decreases as pCO2 increases with lowest being for those with pCO2 >80mm Hg (36%). This difference was found to be statistically significant (P<0.05); i.e. the outcome of NIV was found to be significantly associated with initial pCO2.

Various studies[13] have shown $PaCO_2$ as an independent significant predictor of the need to initiate NIV in AECOPD patients. A study by Bhatt SP et al.[14] had shown that patients with stable COPD with $PaCO_2$ <52 mm Hg can be treated successfully with domiciliary NIV. In a study by K.M. Mclauhlin et al,[15] NIV showed improvement even at a mean $PaCO_2$ of 75 mmHg. Miller D, Fraser K et al[16] showed that lower absolute values of pCO_2 prior to NIV and at 1 h were both associated with successful hospital discharge. But, improvement of pCO_2 at 1 hour was not associated with better outcomes in that study.

SUMMARY

The present study undertaken at **K.N. Chest Hositpal Dr. S. N. Medical College, Jodhpur** to study the Role of NIV in hypercapnic respiratory failure in patients of COPD. A total of 110 patients with a diagnosis COPD with pH 7.20-7.35 and $PaCO_2$>50 mm Hg on ABG, who consented to participate in the study were included. These patients were treated with NIV with oronasal mask along with standard medical treatment according to GOLD guidelines.

Salient features of the study are as follows:

1. Out of the total 110 patients included, 88 were males and 22 were females. The overall mean age of patients was 60.6±8.6 years. Maximum numbers of patients were in age group 61-70 years.
2. Patients with $PaCO_2$>50 mm Hg were included in the study. The study population was divided in to four groups according to initial $PaCO_2$ in ABG. Mean $PaCO_2$ of the study patients at start was 71.90±10.89 mm Hg. 16 patients. (14.55%)had initial $PaCO_2$<60 mm Hg; 45 patients (20.00%) had pCO_2 more the 80 mm Hg.
3. Out of the 110 patients included in the study, 80 patient were successfully treated with NIV, giving a success rate of 72.73%.
4. Success rate was highest in the age group <50 years and then it was decreasing with higher age groups. But the difference was not statistically significant (P=0.177).
5. Male included in the study were having slightly higher success rate of NIV as compared to Female (77.27% vs. 54.55%) the difference was statistically significant (P=0.032).
6. Success rate was lower in patients with pH ≤7.25 as compared to pH-7.25-30 and pH-7.31-35 (33.34% vs. 82.14% respectively). The difference was statistically significant (p<0.001). The subjects with successful outcome of NIV showed gradual increase in mean pH from 7.29 at start to 7.32 after 7.32 after 3 hours and this increase was statistically significant (P<0.001), whereas patients with NIV failure showed significant decrease in mean pH from 7.259 to 7.25 after 3 hours (P<0.05).
7. Mean $PaCO_2$ of the population at time of inclusion in the study was 71.90±10.89mm Hg. The success rate of NIV was higher in patients with pCO2 <60 mm Hg (100%) and gradually decreases as pCO2 increases with lowest being for those with pCO2 >80 mm Hg (36.36%). The difference was found to be statistically significant at P<0.05; i.e. Outcome of NIV was more likely to be successful in patients with lower initial pCO2. The subjects with successful outcome of NIV showed gradual decrease in mean pCO2 from 69.07 mm Hg to 64.19 mm Hg after 3 hours and this decrease was statistically significant Patients with NIV failure showed significant increase in mean pCO2 from 80.57 to 84.54 mm Hg after 3 hours (P<0.001).

CONCLUSION

NIV is a cost effective intervention in acute exacerbation of COPD with hypercapneic respiratory failure. Effective use of NIV results in fewer complicaitons, shorter length of hospital stay, and lower mortality. The need for mechanical ventilation is also reduced. In a low resource setting as we find in our country, admission practices to wards and ICU is usually made arbitrarily. Hence, we propose few parameters which may help in predicting the outcome of NIV in these patients. Patients who have had a history of mechanical ventilation in the past, should be considered high risk and be under close supervision irrespective of their pH and pCO_2. We propose that patients who have a pH of less than 7.25 and a pCO_2 more than 72.5 are better managed in the ICU, whereas those with better parameters may be managed in the ward under close supervision

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