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Research Article

Efficacy of Non Invasive Ventilation in Patients of Respiratory Failure: Study of 50 Patients

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Abstract: Non-invasive ventilation has been shown to be an effective in the mangement of acute hypercapnic respiratory failure, particularly in chronic obstructive pulmonary disease (COPD). The priority of non-invasive ventilation over invasive ventilation has grown over the time, as it leaves the upper airway intact, preserves airway defence mechanisms and allows patients to eat, drink, verbalise and expectorate secretions. Non-invasive ventilation also has the benefit of decreased infectious complications of mechanical ventilation. Fifty patients of respiratory failure admitted in intensive care unit / ward of the tertiary care centre were enrolled for the study. The demographic details, clinical features as well as pre existing lung conditions were recorded and the outcome was studied. Non-invasive ventilation was successful in 64% patients. In those where non-invasive ventilation failed, mortality was high to the tune of 50%. Non-invasive ventilation has a high success rate in both type I and type II respiratory failure. Lower oxygen saturation, lower pH and a higher pCO_2 worsens the outcome.
Keywords: Non-invasive ventilation (NIV), Respiratory failure (RF).

INTRODUCTION

Non-invasive ventilation refers to the delivery of oxygen to the lungs using techniques that do not require an endotracheal airway [1]. NIV within both intensive care unit (ICU) and ward environment, has been reported in randomised controlled trials and systematic reviews to reduce the intubation rate and mortality in chronic obstructive pulmonary disease (COPD) patients with decompensated respiratory acidosis (pH<7.35 and $PaCO_2$ > 6 kPa) following immediate medical therapy [2].

In cardiogenic pulmonary edema, NIV does not result in significantly improved outcomes but it does improve oxygenation faster and reduces the need for intubation.

NIV provides the benefit of leaving the upper airway intact, preserving airway defence mechanisms and allows patients to eat, drink, verbalise and expectorate secretions. It reduces infectious complications of mechanical ventilation, including nosocomial pneumonia and sinusitis.

The study was undertaken to evaluate the use of NIV in patients of respiratory distress and their outcome at tertiary care centre in India.

MATERIALS AND METHODS

Fifty patients of respiratory failure presenting to the tertiary care centre of western Uttar Pradesh were enrolled for the study. The details regarding the age at presentation, symptoms at the time of presentation, pre-existing lung condition along with co-morbidities, and indication of non-invasive ventilation were recorded. The patients were followed up during the hospital stay and their outcome was recorded in terms of need of mechanical ventilation, mortality and improvement in the present respiratory condition with discharge from the hospital.

All the patients having exacerbation of COPD with respiratory acidosis refractory to medical treatment and controlled oxygen therapy, RR > 25/min, use of accessory muscles of respiration, paradoxical abdominal motion, hypoxemia refractory to oxygen therapy and $PaCO_2$> 45 mm Hg were included for the study.

The patients with life threatening hypoxemia, severe co morbidities, cognitive impairment, vomiting, pneumothorax, upper gastrointestinal surgery, copious secretions, hemodynamic instability, and bowel obstruction were excluded.

RESULTS

The present study was conducted at School of Medical Sciences and Research, Sharda University over a period of 6 months. Fifty consecutive patients aged more than fifteen years were enrolled for the study. Mean Age of the study group was 54.65± 9.04 yrs. The most common age group was in the age of 61-75 yrs (Fig. 1). The male to female ratio in the study group was 1.38:1 (Fig. 2). Majority of patients did not have any pre-existing lung disease, however 16% patients had chronic obstructive pulmonary disease (COPD), 8% were asthmatics, 4% had malignant disease, and 4% had history of old Koch's (Table 1).

Diabetes was the commonest co-morbidity seen in 34% patients while 48% were hypertensive. The commonest presenting complaint was breathlessness; the other presenting symptoms are shown in table 2.

It was noted that patients with Oxygen saturation less than 75% had highest mortality (66%) out of all groups (Table 3).

Similarly, patients with a pH < 7.25 had higher NIV failure and higher mortality rates than comparative groups. Also, a pCO_2> 60 was an indicator of worse prognosis (Table 4 and 5).

Table 1: Pre-existing illness in the patients requiring ventilatory support

Diseases	No. of patients	Percentage
COPD	8	16
Asthma	4	8
Pulmonary tuberculosis	2	4
Malignancy	2	4
None	34	68

Table 2: Symptoms at the time of presentation

Symptoms	No. of patients	Percentage
Breathlessness	41	82
Fever	26	52
Cough	21	42
Chest pain	4	8
Haemoptysis	3	6

Table 3: Improvement in patients on NIV on basis of initial oxygen saturation

SpO_2	No. of patients	Intubation	Mortality	Improved	Percentage Improved
< 75	3	2	2	1	33.3
76-80	3	2	0	1	33.3
81-85	6	3	1	3	50
86-90	23	8	4	15	65.21
>90	15	4	2	11	73.3

Table 4: Improvement in patients on NIV on basis of initial respiratory acidosis

pH	No. of patients	Intubation	Mortality	Improved	Percentage Improved
<7.25	1	1	1	0	0
7.26-7.35	8	3	2	5	62.5
7.36-7.45	19	7	4	12	63.16
>7.45	21	7	2	14	66.66

Table 5: Improvement in patients on NIV on basis of initial PCO2

PCO_2	No. of patients	Intubation	Mortality	Improved	Percentage Improved
<20	1	1	1	0	0
21-30	4	2	1	2	50
31-40	27	8	3	19	70.37
41-50	7	2	1	5	71.4
51-60	5	2	1	3	60
>60	6	4	2	2	33.3

Malignant disease (40%) followed by bronchial asthma (25%) were the diseases with high mortality in patients requiring NIV in our study. It was also found that patients requiring mechanical ventilation had a higher mortality. NIV was 100% successful in patients with COPD exacerbation. Overall, NIV was successful in 62% patients and the mortality in our study group was 18%.

DISCUSSION

The non invasive application of positive pressure dates back to 1930s when the pioneering studies of Alvan Barach demonstrated that continuous positive airway pressure could be useful in the treatment of acute pulmonary edema [3]. It came into much use in 1980s with the introduction of nasal continuous positive airway pressure mask for the treatment of obstructive sleep apnea [4]. Thereafter, the success of NIV in both acute and chronic respiratory conditions has been reported [5].

The present study demonstrates that NIV is successful in more than 60% cases of acute respiratory failure whether it is hypoxemic respiratory failure or that with associated hypercapnia. The associated co morbidities may play a role in final outcome of patient and it needs further studies to document the related prognosis due to co morbid conditions. The prognosis worsens with lower saturation (<75%), lower pH (7.25) and a higher pCO2 (>60mm).NIV may improve the respiratory status in patients with Malignancy but is unable to alter the final outcome in these patients.

Studies have demonstrated that the initial pH upon presentation is important in determining outcome from NIV. A large multicentre European analysis of 1033 patients with acute hypercapnic COPD requiring NIV suggested that if the initial pH was $\leq$7.25, there was a significantly higher odds ratio (OR 1.97, 95% CI 1.23–3.15) of failure with NIV, with pH being the most important biochemical variable [6]. Similarly, Moretti *et al*. found initial pH as the strongest physiological predictor of NIV success in a group of 137 patients with acute hypercapnic COPD [7]. Squadrone *et al*. reported high failure rate (63%) with the use of NIV in a severely acidotic (pH<7.25) group of 64 COPD patients managed in intensive care unit (ICU) [8]. Many studies have reported pH<7.20 as an indication for ETI [9].

The largest randomised controlled study examining the effects of NIV delivered in UK general district hospital medical wards on ARF in COPD exacerbations found that the subgroup of patients with a pH 7.30 tended to have a worse outcome when treated with NIV than less acidosis patients [10]. However, this study was not specifically powered for this subgroup analysis. Guidelines for the use of NIV usually reported pH thresholds of 7.25. NIV below it may not be as effective and safe [11-13].

Moreover, in controlled and uncontrolled trials of NIV a low initial pH [14, 15] and a high $PaCO_2$ have been found to be associated with a poor outcome [14-16]. A fall in $PaCO_2$ and improvement in pH have also been reported to be protective [14-17].

It is important to consider the variables which are not significant in analysis, notably hypoxia and radiographic consolidation. Hypoxia on admission in acute exacerbations has not been reported to be associated with mortality or the need for intubation. Similar findings in this study are not surprising [14-18].

CONCLUSION

Non-invasive ventilation has a high success rate in both type I and type II respiratory failure. Lower oxygen saturation, lower pH and a higher pCO2 worsens the outcome.

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