

Management of Respiratory Failure associated with Acute Exacerbation of COPD and the role of Non-Invasive Ventilation (NIV)

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Chronic obstructive pulmonary disease (COPD) is a disorder common to both developed and developing countries. The major risk factor for the development of COPD remains cigarette smoking¹. Once the disease is established, it leads to rapid decline in lung function superimposed on slow age related decline in lung function. The course of the disease is characterized by recurrent episodes of infective exacerbations at a frequency of 1-4 times/year² and results in increased symptoms of cough, dyspnea and sputum production. There is accompanying hypoxia, hypercapnia and acidosis leading to deterioration of cardiovascular and neurological functions. These exacerbations of COPD are a major burden on health resources, lead to loss of earning potential and may lead to death. The mortality rate rises dramatically when COPD exacerbation is associated with hypercapnia and type II respiratory failure.

Management of exacerbation of COPD with type II respiratory failure involves controlled oxygen therapy, use of nebulized bronchodilators, appropriate antibiotics and possibly systemic corticosteroid therapy³. Supplemental O₂ is given at low flow rates (FiO₂) of 24-28% to raise PaO₂ to safe limits of around 60 mmHg. Attempts to raise PaO₂ to higher values by giving high flow rates of O₂ may prove counterproductive since this abolishes the hypoxic drive to breathing and worsens hypercapnia. In this context it is important to remember that in these patients nebulizer should preferably be given with air compressor machines and not through oxygen cylinders. Bronchodilators should preferably be given by nebulized route, as this is rapidly effective and has a better safety profile than systemic medications. Anticholinergic (ipratropium) and beta₂ agonist (salbutamol) are the commonly used compounds, the latter being cheaper and more easily available in our country. Antibiotic therapy should cover the common infecting organisms (*S. pneumoniae*, *H. influenzae* and *M. catarrhalis*). A β-lactamase resistant penicillin or macrolide is appropriate for most cases with quinolones used for more severe cases. Respiratory stimulants e.g. doxapram and nikethemide are not generally very effective and have undesirable side effects of confusion and convulsions.

Those patients who do not respond to the medical therapy need ventilator support to improve the respiratory failure. The ability to initiate mechanical ventilation is dependant on a number of factors. In a resource poor country like Pakistan, there is a chronic shortage of ventilators and ICU beds. Even if a bed is available, patients' financial constraint may not allow them to afford ICU treatment. Treating physicians have always been wary to initiate mechanical ventilation in severe COPD patients whose pulmonary reserves are very low and who may not be able to be weaned off the ventilator. Many elderly patients or their relatives may not consent to endotracheal intubation and ventilation. Non-invasive ventilation (NIV) is a breakthrough in the management of hypercapnic respiratory failure during COPD exacerbation. The term NIV is used because the patient does not require endotracheal intubation, preventing trauma to the airways. The machines used for NIV are smaller, cheaper and easier to operate than the conventional mechanical ventilators. They are called BiPAP (bi-level positive airway pressure) or CPAP (continuous positive airway pressure) machines and deliver ventilation through a comfortable mask applied tightly over the nose or the face. Respiratory support is delivered in synchrony with the patient's inspiratory effort, which results in an increase in the tidal volume and reduction in respiratory effort performed by the patient.

There are now a number of randomized, controlled studies showing the benefit of NIV in COPD

patients with respiratory failure⁴. NIV is not only an effective therapy, but has other advantages over conventional ventilation. NIV is less expensive, leads to shorter hospital stay, fewer complications and decreased mortality compared to immediate intubation and ventilation. Brochard et al. in their study showed that the mortality was decreased from 29% to 9%, intubation rate from 74% to 16%, major complications from 48% to 16% and length of stay from 35 days to 23 days⁵. Other advantages of NIV are that it can be applied inwards other than ICU, it avoids the need for sedation, is applied intermittently and that the patient retains its ability to eat and talk. In a recent multicentre randomized controlled trial conducted in UK, use of NIV during exacerbations of COPD was evaluated in general respiratory wards⁶. Use of NIV led to a more rapid improvement in respiratory rate and arterial pH compared to standard medical therapy alone. There was a significant reduction in mortality and the need for invasive mechanical ventilation. There is enough Level I evidence to support the use of NIV in patients with a PCO₂>50mmHg, a pH<7.35 and a respiratory rate >30.

The paper by Rizvi et al. in this issue not only highlights the efficacy of this technique during COPD exacerbations complicated by type II respiratory failure but the fact that NIV can be applied effectively on respiratory wards in government hospitals⁷. The sample size was small along with some other limitations in their study design, but one has to remember that the field of NIV is still in infancy in Pakistan and the authors deserve credit for their effort. The inspiratory pressure (IPAP) used in their study was only 10 cm, which is much lower than that is needed in type II respiratory failure (usually around 20 cm). One third of their patients (6/18) had initial pH of 7.22 or less and were at a higher risk of failure from NIV but despite this their response rate remained excellent. It is possible that the patient selection was not stringent and patients with initial poor response or poor tolerance to procedure were not included in the analysis. In fact the two patients who died had a better initial pH, had good correction of physiological variables and seem to have died of causes other than worsening of respiratory failure.

It is important to remember that NIV has its limitations. Failure rates of 7-50% have been reported in COPD patients and it is relevant that selection of patient for NIV should be appropriate. NIV should not be used in patients with absent respiratory efforts, severe hemodynamic instability, poor conscious level or high risk of aspiration. The ability to predict the outcome of NIV before initiation is important⁸. A number of studies have shown a low starting pH to be associated with a poor outcome. Other factors include associated complications and poor pre-morbid state of the patient. Tolerance of NIV and improvements in pH, PCO₂ and respiratory rate at 1-2 hours after initiation therapy are subsequent indicators of success. Most of the studies looking at poor prognostic factors are retrospective and should be viewed with caution. Patient should not be denied a trial of NIV if some of the poor prognostic factors are present but need to be monitored more closely for the response of therapy or the lack of it.

Finally, it is important to point out that NIV is not only effective for COPD patients with type II respiratory failure but has been used successfully in a variety of other conditions leading to respiratory distress and/or respiratory failure^{9,10}. It is indicated when hypoxia (type I respiratory failure) is not readily corrected by medical measures and oxygen therapy is needed e.g. in pneumonia, acute asthma and pulmonary edema¹¹. When used in emergency room, NIV may obviate the need for endotracheal intubation and mechanical ventilation. Type II respiratory failure due to pulmonary diseases other than COPD may also respond well and NIV has been successful in treating patients with chronic respiratory failure due to neuromuscular and skeletal diseases¹².

In conclusion, management of patients with acute exacerbation of COPD, in addition to medical therapy, should include NIV if they present with moderate respiratory acidosis (pH< 7.35 and PCO₂>50). Patients who fail to respond or have contraindication to NIV should be evaluated for endotracheal intubation and mechanical ventilation. NIV is a welcome advancement in the management

of respiratory failure.

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