Efficacy of noninvasive positive pressure ventilation in limiting re-intubation of COPD patients after extubation

Thesis

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ABG	:	Arterial blood gases
APACHE II	:	Acute Physiology and Chronic Health Evaluation II
ARDS	:	Acute respiratory distress syndrome
BiPAP	:	Bi-level positive airway pressure
COPD	:	Chronic obstructive pulmonary disease
CPAP	:	Continuous positive airway pressure
CROP	:	Compliance, respiratory rate, oxygenation and pressure system
ED	:	Emergency department
EMG	:	Electromyography
ETT	:	Endotracheal tube
ETI	:	Endotracheal intubation
FRC	:	Functional residual capacity
ICU	:	Intensive care unit
LOS	:	Length of stay
MAP	:	Mean arterial pressure
NIPPV	:	Non-invasive positive pressure ventilation

NPV	:	Negative pressure ventilation
PEEP	:	Positive expiratory end pressure
RSBI	:	Rapid shallow breathing index
SBT	:	Spontaneous breathing trials
SD	:	Standard deviation
FEV1	:	forced expiratory volume in one second

INTRODUCTION

Mechanical ventilation supports respiration for many patients and without it, they would die within hours to days due to acute hypoxemic and/or hypercapnic respiratory failure. Observational, physiological and case- control studies from a large body of evidence demonstrates that non-invasive positive pressure ventilation (NIPPV) can be used in many situations to decrease patients' dyspnea and work of breathing, improve gas exchange and ultimately avoid the need for endotracheal intubation (ETI) ***(Burns et al., 2010).***

Invasive ventilation via endotracheal tube (ETT) can be lifesaving, but is also associated with numerous complications, including airway injury, higher risk for gastrointestinal bleeding, thromboembolism, ventilator associated lung injury, and ventilator associated critical care myopathy/polyneuropathy. Many of these complications are more likely if invasive ventilation is prolonged; not an uncommon occurrence ***(Ferrer et al., 2003).***

Approximately 25% of patients intubated for acute respiratory failure require at least 7 days of mechanical ventilation, and up to 10% are intubated for more than 3 weeks. One study found that 40% of ventilator time was devoted to weaning (60% in patients with chronic obstructive pulmonary

diseases [COPD]). Mortality increases with increased duration of ventilation ***(Blackwood et al., 2010)***.

Post-extubation respiratory failure is a rather common event after discontinuation of mechanical ventilation. Re-intubation is needed in about 10% of patients, i.e. a range between 4% and 24% of patients. The use of NIPPV has expanded dramatically over the last 2 decades ***(Epstein, 2001)***.

One of the important NIPPV applications that has emerged, is to shorten the duration of mechanical ventilation by facilitating weaning (earlier extubation); in the postoperative period, to prevent re-intubation; and after planned extubation ***(Vignaux et al., 2009)***.

It has been shown that there is a clearly identified subset of patients (those with comorbid conditions, increased work of breathing at time of failure, chronic heart failure patients and upper airway obstruction) at high risk of requiring re-intubation ***(Kilger et al., 1999)***.

Patients who require re-intubation have been noted to have a significantly higher mortality rate than those who are successfully extubated on the first attempt because that their increased risk of death may include both difficulties encountered during the re-intubation period and the development of additional ventilator-

related complications, such as pneumonia. The need for re-intubation may also be a marker of increased severity of illness, but after adjustment for both coexisting conditions and severity, extubation failure is still and independent predictor of death. This suggests that, at least to some extent, the increased mortality seen in these patients may be reduced by treatments aimed at reducing the need for re-intubation ***(Macintyre, 2012)***.

The significant advances and clinical benefits of non-invasive positive pressure ventilation (NIPPV) in initial management of respiratory failure in chronic obstructive pulmonary diseases (COPD) patients and acute cardiogenic pulmonary oedema have led to use of this technique following extubation. Currently non-invasive mechanical ventilation is recognized as effective method of weaning and early extubation of mechanically ventilated patients of chronic obstructive pulmonary diseases (COPD), due to morbidity and mortality risks associated with re-intubation ***(Ambrosini et al., 1995)***.

Non-invasive positive pressure ventilation, however, is not without its problems, and failure rate of 7 to 50% have been reported. Severe respiratory acidosis and illness at presentation, excessive airway secretions, and inability to minimize the amount of air leakage are major factors associated with failure of non-invasive mechanical ventilation ***(Keenan et al., 2002)***.

AIM OF THE WORK

This study is designed to assess the efficacy of early application of non-invasive positive pressure ventilation in preventing re-intubation after planned extubation in mechanically ventilated adult COPD patients.

Natural breathing and mechanical ventilation

Natural breathing is a spontaneous physiological process that occurs when the respiratory muscles, diaphragm and intercostal muscles pull on the rib cage, creating a negative inspiratory pressure. This results in lung expansion and the pulling of air into the alveoli allowing the process of gas exchange to occur. Therefore, spontaneous respiration occurs by negative inspiratory force ***(Rodríguez-Molinero et al., 2013)***.

When spontaneous breathing is absent or impaired, mechanical ventilation aids or replaces natural breathing, so may be used for a few minutes or several months depending on the medical situation. In extreme cases, a patient may require mechanical ventilation for the rest of his life ***(Raven et al., 2007).***

Mechanical ventilation is the most commonly used organ support in intensive care units (ICU), in the healthcare setting or home; it helps patients breathe by assisting the inhalation of oxygen into the lungs and the exhalation carbon dioxide. Depending on the patient's condition, mechanical ventilation can help support or completely control breathing.

Several forms of external support for respiration have long been described to assist the failing ventilator pump, and access to lower airways through tracheostomy or endotracheal tubes had

constituted a major advance in the management of patients with respiratory distress along the past 20 years ago. However, new non-invasive positive pressure ventilation (NIPPV) techniques, using patient/ ventilator interfaces in the form of facial masks, have been designed **(*Mehta and Hill, 2001).***