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Prevention of extubation failure in high-risk patients with neuromuscular disease☆,☆☆,★

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Abstract

Background: A substantial proportion of patients with neuromuscular disease (NMD) who undergo positive pressure ventilation via endotracheal intubation for acute respiratory failure fail to pass spontaneous breathing trials and should be considered at high risk for extubation failure. In our study, we prospectively investigated the efficacy of early application of noninvasive ventilation (NIV) combined with assisted coughing as an intervention aimed at preventing extubation failure in patients with NMD.

Methods: This study is a prospective analysis of the short-term outcomes of 10 patients with NMD who were treated by NIV and assisted coughing immediately after extubation and comparison with the outcomes of a population of 10 historical control patients who received standard medical therapy (SMT) alone. The participants were composed of 10 patients with NMD who were submitted to NIV and assisted coughing after extubation (group A) and 10 historical control patients who were administered SMT (group B), who were admitted to a 4-bed respiratory intensive care unit (RICU) in a university hospital. Need for reintubation despite treatment was evaluated. Mortality during RICU stay, need for tracheostomy, and length of stay in the RICU were also compared.

Results: Significantly fewer patients who received the treatment protocol required reintubation and tracheostomy compared with those who received SMT (reintubation, 3 vs 10; tracheostomy, 3 vs 9; $P = .002$ and .01, respectively). Mortality did not differ significantly between the 2 groups. Patients in group A remained for a shorter time in the RICU compared with group B (7.8 ± 3.9 vs 23.8 ± 15.8 days; $P = .006$).

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Conclusions: Preventive application of NIV combined with assisted coughing after extubation provides a clinically important advantage to patients with NMD by averting the need for reintubation or tracheostomy and shortening their stay in the RICU; its use should be included in the routine approach to patients with NMD at high risk for postextubation respiratory failure.

1. Introduction

The onset of acute respiratory failure (ARF), in most cases because of respiratory tract infection, is a crucial event in the advanced stage of most neuromuscular diseases (NMDs) and a major cause of death, unless mechanical ventilation (MV) is used [1-3].

Although noninvasive ventilation (NIV) can be a safer and more effective alternative to endotracheal intubation (ETI) in the treatment of neuromuscular ARF [4,5], contraindications still remain to the application of NIV in the acute setting, including respiratory arrest, severe inability to protect the airway, uncontrollable airway secretions despite use of noninvasive aids, life-threatening hypoxemia, severely impaired mental status or agitation, hemodynamic or electrocardiographic instability, and bowel obstruction [6]. If a contraindication to NIV exists, positive pressure ventilation (PPV) via ETI constitutes the approach for treating patients with ARF who require ventilatory support. Unfortunately, because of weakness of the inspiratory muscles, inadequate cough, and inability to handle oropharyngeal secretions, a substantial proportion of patients with NMD who undergo invasive PPV fail to pass spontaneous breathing trials (SBTs) after recovery from the acute illness and should be considered at high risk for extubation failure [2,7,8]. It should be emphasized that extubation failure is an outcome to be avoided because it is independently associated with increased hospital mortality, prolonged intensive care unit (ICU) and hospital stay, higher costs, and greater need for tracheotomy [9]; therefore, strategies preventing this occurrence are required.

To avert extubation failure in patients at high risk, recent studies have evaluated the effectiveness of NIV as a preventive strategy, concluding that its application can reduce the need for reintubation and mortality rate in the ICU and suggesting its early use after extubation in individuals with chronic respiratory disorders (including chronic obstructive pulmonary disease, obesity hypoventilation, sequelae of tuberculosis, chest wall deformity, and chronic persistent asthma), congestive heart failure, and/or hypercapnia [10-12].

Sporadic case reports and small case series in the literature have demonstrated that NIV can be successfully applied to avoid reintubation and tracheostomy in patients with NMD [13-16]. In addition, a recent, large, noncontrolled study showed that the standardized use of NIV and cough assist can lead to effective extubation of almost all "unweanable" patients with NMD who could not pass an SBT, supporting the argument that timely provision of inspiratory and expiratory aids allows for virtual elimination of postextubation failure in patients with neuromuscular disorders [17].

These encouraging results and the dearth of controlled clinical studies prompted us to prospectively investigate the efficacy of a protocol providing early application of NIV combined with assisted coughing as an intervention aimed at preventing extubation failure in patients with NMD who have required ETI for ARF. To this end, we analyzed the clinical course of 10 subjects with advanced NMD at high risk for reintubation who were extubated after an episode of ARF and were submitted to NIV combined with assisted coughing and compared the results with the outcomes of 10 historical control patients who received standard medical therapy (SMT) after extubation. In particular, we hypothesized that the early use of NIV plus cough assist might outperform conventional treatment in terms of need for reintubation and tracheostomy, mortality, and length of stay in the ICU.

2. Methods

We compared the short-term outcomes of 10 patients with NMD extubated after an episode of ARF who were treated by NIV and assisted coughing after extubation (group A) with the outcomes of a population of 10 historical control patients who received SMT alone after extubation (group B). The patients gave their informed consent to the application of NIV and assisted coughing; those younger than 18 years reached this decision in accordance with their parents. The study was approved by the institutional review board.

2.1. Patients

Ten consecutive patients with NMD admitted to the respiratory ICU (RICU) of the City Hospital of Padova between January 2008 and April 2010 who had been intubated and ventilated for more than 48 hours and who were considered at high risk for developing postextubation respiratory failure were recruited (group A). The diagnoses were based on standard clinical, enzymatic, electromyographic, DNA, and biopsy data.

The ability to cough was assessed using the measurement of peak cough expiratory flow (PCEF) obtained from pulmonary function testing done in stable clinical conditions