Commentary

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Protocols for Weaning From NIV: Appraisal of Evidence

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Introduction

Ventilatory support by artificial machines for respiratory failure used in 1950s during Copenhagen polio epidemic revolutionized the management of critically ill patients [1-3]. Ventilatory support provided by "Iron – lung" during that epidemic was without need for placement of endotracheal tube, i.e., non-invasive ventilation [1-3]. These ventilators though saved many lives during the polio epidemic however had many inherent limitations and were not suitable for all, especially patients with problem in respiratory derive. Over next few years, with better understanding and advancement in technology, these non-invasive ventilators were replaced by mechanical ventilators requiring endotracheal intubation [1]. These ventilators were superior to "Iron – lung" with facility of manual control of many parameters important for ventilation. Use of these mechanical ventilators has saved numerous lives of critically ill patients over last many years. However, the ventilatory support using endotracheal intubation was also associated with many complications which lead to increased morbidity and mortality [4, 5]. Many of these complications were attributed to the presence of endotracheal tube. Therefore, it is recommended that attempts should be made to extubate the patient as early as he / she recovers from the condition leading to respiratory failure. Extubation of these patients sometimes may be a challenge however currently; standard protocols are available for process of extubation and weaning from mechanical ventilation [5-7].

After many years of initial successful use, renewed interest for non – invasive ventilation (NIV) came into practice to minimize the complications related to the presence of endotracheal tube [8]. Subsequent years showed that NIV may be used successfully in many patients with respiratory failure without need for placement of endotracheal tube [8-10]. Multiple well-designed studies have been published showing utility of NIV among patients with acute exacerbation of chronic obstructive pulmonary disease (COPD), acute cardiogenic pulmonary edema, pneumonia among immunocompromised hosts and various other conditions [11-13]. The strength of evidence leads to the recommendation by various scientific organization to recommend NIV as first line standard of care for these patients. Currently, nobody doubts the utility of NIV and most of the critical care physicians are comfortable in providing NIV for such patients. However, there is limited information regarding how to wean these patients from NIV. This article will discuss various protocols which can be followed for weaning of patients from NIV.

Possible Weaning Strategies

Before attempting weaning one has to assess whether the patient is ready for wean or not. A patient who has recovered from the underlying condition and has acceptable clinical and physiological parameters (weaning criteria) he / she, is ready for weaning from NIV. The clinical and physiological parameters used in this setting include – arterial pH ≥ 7.35, oxygen haemoglobin saturation (SpO_2) > 90% on FiO_2 ≤ 50%, respiratory rate ≤ 25 / min, heart rate ≤ 120 / min, systolic blood pressure ≥ 90 mmHg and no signs of respiratory distress like agitation, diaphoresis or anxiety. Patient satisfying these criteria, there can be three ways by which weaning from NIV may be done – stepwise reduction of duration of NIV use, stepwise reduction in pressure support and immediate withdrawal of NIV.

Stepwise reduction of NIV use

This strategy involves gradually increasing the NIV free interval over few days (usually 2 – 3 days) and then complete removal of NIV.

Stepwise reduction of pressure support:

It involves gradual reduction (2 cm – 4 cm of H_2O) of inspiratory positive airway pressure (IPAP) and expiratory positive airway pressure (EPAP) every 4 h – 6 h. The NIV may be removed once

patient is able to tolerate the IPAP of 6 cm – 8 cm of H_2O and EPAP of 4 cm – 6 cm of H_2O.

Immediate withdrawal of NIV

This strategy involves immediate removal of NIV once patient is fulfilling above mentioned weaning criteria.

Evidence of Utility of Various Protocols

The protocol using step wise reduction of NIV use was proposed by Plant and colleagues [14]. They published a study in which on day - 1, patients were encouraged to use NIV as much as possible, on day - 2 for 16 h, and day - 3 for 12 h. NIV was routinely discontinued on day - 4, although an option to continue it was available if clinically indicated. Stepwise reduction in NIV use for weaning was also used by Damas and colleagues [15]. Their study included 78 patients requiring NIV for acute exacerbation of COPD. Weaning was considered when patient had a pH of ≥ 7.35 and respiratory rate of ≤ 25 / min for 24 h. The protocol involved increasing NIV free period over three days. They divided 12 hours of the whole day into 4 parts, each consisting of 3 hours. On day – 1, during the day each 3 h, 1 h was without NIV and NIV was used for whole night. On day – 2, during the day each 3 h, 2 h was without NIV and 1 h with NIV; NIV was used for whole night. On day – 3, only supplemental oxygen was used and NIV was not used during the day; NIV was used only during night. Authors found this protocol safe and there was no case of failure requiring re-institution of NIV.

Immediate withdrawal of NIV seemed a possible way to wean patients from NIV. The potential advantage of this strategy is considerable shortening of the weaning process however risk of failure and need for re-institution of NIV is a major concern. Lun et al. compared stepwise withdrawal versus immediate withdrawal of NIV to address this issue [16]. The study included 35 and 25 patients in stepwise withdrawal and immediate withdrawal group, respectively. The protocol for stepwise withdrawal was as follows - the duration of NIV use was reduced to 16 hours on the day of randomization (day - 0), then reduced to 12, 8 and 0 h on days 1–3, respectively. Following this protocol the success rate of weaning were 74% and 56% for stepwise and immediate withdrawal group, respectively. The success rate of weaning seemed better with gradual withdrawal strategy however the difference was not statistically significant (p – 0.139). Based on the results of this trial British Thoracic Society and Royal College of Physicians (BTS / RCP) included protocol for weaning from NIV in the evidenced based guidelines for clinical management [17]. Third possible strategy for weaning from NIV includes stepwise reduction in pressure support. There is no published study which has assessed the utility of gradual reduction of pressure support (IPAP and EPAP) for weaning from NIV. At our institute we conducted a trial comparing all three possible strategies for withdrawal of the NIV – stepwise reduction in pressure support or duration of NIV use or immediate withdrawal of NIV. This was randomized controlled trial which included 30 patients in each arm. Protocol adopted for stepwise reduction of pressure support included the reduction in pressure support by 2 cm – 4 cm H_2O every 4 h - 6 h till IPAP < 8 cm of H_2O and EPAP < 4 cm of H_2O was attained after which NIV was completely withdrawn. The stepwise reduction of duration of NIV was done as follows the NIV was used for 16 h on the day of randomization (day 0), then reduced to 12 h on day 1 (including 6 h - 8 h of overnight use), 6 h - 8 h of overnight use on day - 2 and complete withdrawal on day - 3. In the immediate withdrawal group NIV was immediately withdrawn. The full results will be published shortly however there were no significant difference between three groups in the probability of successful withdrawal. Many of these patients also require oxygen during NIV. Once patient has recovered from respiratory failure and weaned from NIV weaning from oxygen should also be started. British Thoracic Society has published evidence based guidelines regarding various aspects of oxygen therapy including weaning [18]. In our ICU, we follow same guidelines for weaning of these patients from oxygen.

Conclusion

Current data regarding weaning strategies from NIV is limited. This is further complicated by different protocols followed by the authors. However, it seems that immediate withdrawal from NIV has the highest failure rate leading to re-institution of NIV. In our experience, there was no difference in the success of weaning using either stepwise reduction of pressure support or duration of NIV use. BTS / RCP recommend a protocol using stepwise reduction in NIV use which takes 4 days for weaning [17]. In this protocol patients are asked continue NIV for as much as possible on day - 1, for 16 h (including 6 h - 8 h overnight) on day - 2 h and 12 h on day - 3 (including 6 h - 8 h overnight). NIV may be discontinued on day - 4 unless continuation is clinically indicated [17]. These guidelines are based on a multicenter randomized controlled trial designed to compare the effect of NIV and standard medical treatment among patients with acute exacerbation of COPD [14]. This study was not designed for comparison of different methods of NIV withdrawal however the above mentioned protocol was found to be useful in this setting. In my opinion, this is a reasonable strategy and may be adopted in day to day practice. Well-designed randomized studies with adequate sample size are needed to find the best strategy for weaning from NIV.

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