



Non-invasive ventilation 2

Ventilatory support after extubation in critically ill patients

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This is the second in a Series of two papers about non-invasive ventilation

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The periextubation period represents a crucial moment in the management of critically ill patients. Extubation failure, defined as the need for reintubation within 2–7 days after a planned extubation, is associated with prolonged mechanical ventilation, increased incidence of ventilator-associated pneumonia, longer intensive care unit and hospital stays, and increased mortality. Conventional oxygen therapy is commonly used after extubation. Additional methods of non-invasive respiratory support, such as non-invasive ventilation and high-flow nasal therapy, can be used to avoid reintubation. The aim of this Review is to describe the pathophysiological mechanisms of postextubation respiratory failure and the available techniques and strategies of respiratory support to avoid reintubation. We summarise and discuss the available evidence supporting the use of these strategies to achieve a tailored therapy for an individual patient at the bedside.

Introduction

The peri-extubation period represents a crucial moment in the management of critically ill patients. Postextubation acute respiratory failure (ARF) occurs in 10–20% of patients who meet all weaning criteria and successfully perform a spontaneous breathing trial, who might require emergency reintubation.^{1,2} Reintubation is usually related to airway failure (aspiration, ineffective cough, or upper airway obstruction), weaning failure (primary respiratory failure, congestive heart failure, onset of new sepsis, acute coronary syndrome, or neurological impairment), or surgical complications such as bleeding or anastomotic leak.¹ In particular, surgical complications are a major cause of extubation failure in the postoperative setting, needing prompt identification and correction.

Extubation failure has been defined as the need for reintubation occurring within 2–7 days after a planned

extubation,^{1,3} resulting in increased mortality (25–50%), prolonged mechanical ventilation, increased frequency of ventilator-associated pneumonia, and longer intensive care unit (ICU) and hospital stays.^{4,7} It is therefore essential to identify patients at high risk of postextubation ARF in order to choose an appropriate strategy of respiratory support able to improve their outcome.

Conventional oxygen therapy (COT) is commonly used to correct residual oxygenation impairment after extubation, a condition reported as a frequent cause of weaning failure.^{8,9} Although COT can improve oxygenation, it has only a minimal effect on the main pathophysiological mechanisms which can lead to postextubation ARF and reintubation (eg, atelectasis, excessively high respiratory workload, or decreased respiratory muscle force). Non-invasive ventilation (NIV) and high-flow nasal therapy (HFNT) have been implemented as effective alternative approaches aimed at protecting extubation.^{10–12}

In this Review we will describe: the pathophysiological mechanisms of postextubation ARF, the main techniques of non-invasive respiratory support used after extubation (NIV, HFNT, and COT), strategies of postextubation respiratory support (facilitative, preventive, and therapeutic) and their indications to achieve a tailored therapy for specific types of patient, and areas of uncertainty and of future research.

Pathophysiological changes related to extubation

Extubation and the subsequent passage from positive pressure mechanical ventilation to unassisted breathing are the cause of several pathophysiological changes in the airway status or in the weaning (cardiorespiratory) status, including lung aeration, haemodynamics, and neuromuscular function, which, alone or in association, are the substrate for extubation failure, especially in high-risk patients (figure 1).

Changes in airway status

Upper airway obstruction is one of the common causes of extubation failure (2–16% of ICU patients), requiring, in

Key messages

- Extubation failure is associated with prolonged mechanical ventilation, increased frequency of ventilator-associated pneumonia, longer stays in the intensive care unit and in the hospital, and increased mortality
- Identifying patients at greater risk of extubation failure is important for choosing the appropriate technique of non-invasive ventilatory support to improve weaning outcome
- Several techniques of respiratory support (conventional oxygen therapy, high-flow nasal therapy, continuous positive airway pressure, and non-invasive ventilation) can be used with different strategies (facilitative, preventive, or therapeutic) to avoid extubation failure
- Any postextubation respiratory support treatment should not delay intubation and escalation to invasive mechanical ventilation, when this is more appropriate
- In the era of precision medicine and personalisation of care, future studies are needed to help clinicians to use the right device, with the right setting, in the right patient, at the right time