37.1 Introduction

Several studies have examined the benefit of noninvasive ventilation (NIV) as first-line therapy in some critically ill patients versus conventional therapy [1]. Currently, NIV is frequently started outside the intensive care unit (ICU)—not only in the emergency department but also in general wards with less-extensive monitoring facilities [2, 3]. Plant et al. [4] showed that it is possible to apply NIV to patients with chronic obstructive pulmonary disease (COPD) and hypercapnic acute respiratory failure (ARF) in the general ward provided the respiratory failure is not severe (assessed by pH > 7.30). A European survey of a European Respiratory Society Task Force [5] defined the ICU as a location with a high staff-to-patients ratio and facilities for performing invasive ventilation and monitoring. It defined a respiratory intermediate ICU (RIICU), or a high-dependency unit, as a specific clinical area that has the capability of performing continuous vital sign monitoring and a staff-to-patient ratio somewhere between those for an ICU and a general ward.
Clinical criteria for performing NIV in an RIICU are based on mental status and the presence (or absence) of multi-organ failure [1]. The increased risk of pneumonia attributable to endotracheal intubation (ETI) has stimulated the use of alternative tools to deliver positive-pressure ventilation. The use of NIV is associated with lower rates of nosocomial infection, so its use should be encouraged whenever appropriate [6]. Nevertheless, a document endorsed by the European Respiratory Society and the European Society of Intensive Care Medicine stated that NIV should not be considered an alternative to ETI for ARF secondary to infection with the H1N1 virus that is worsening to become acute respiratory distress syndrome (ARDS) [7]. According to this document, however, NIV can be considered to prevent further deterioration and avoid the need for ETI in patients with mild to moderate hypercapnic or hypoxemic ARF and/or distress due to cardiogenic pulmonary edema in the absence of pneumonia, multiple organ failure, and/or refractory hypoxemia. It can be also used to prevent postextubation respiratory failure in patients with improving ARDS secondary to H1N1 infection, preferentially when the patient is no longer contaminated. These warnings are even more important when considering the potential use of NIV for ARF due to high-risk infections outside the ICU.

### 37.2 Patients

Despite the fact that specific randomized studies are lacking, severely ill patients should be treated immediately in the ICU [1]. Hypercapnic COPD patients with ARF due to infection can be treated in the general ward provided isolation is not necessary and the staff has adequate expertise [7]. In these cases, minimum monitoring includes regular assessment of the respiratory, hemodynamic, and neurological functions by adequately trained personnel 24 h a day [4]. In contrast, severely hypoxemic ARF should be treated at least in an RIICU, where monitoring and prompt ETI are available, thereby avoiding dangerous delays to appropriate treatment. In other words, the selection of patients must take into account the location where NIV is performed.

### 37.3 Equipment

Several studies have analyzed the acute use of NIV for respiratory infections in hospitals. They showed a lower infection rate for patients on acute NIV compared to those on invasive or conventional ventilation [8]. Risk factors for these patients on NIV include the ventilator, humidifier, and their circuits. Specifically designed NIV ventilators are used on general wards and in RIICUs. They often have only one tube from the ventilator to the patient, with an exhalation valve to the external environment. On the one hand this design means a lower risk of ventilator contamination because there is no airflow from the patient back into the ventilator. On the other hand, there is an increased risk of environmental and caregiver airborne
contamination. Studies have confirmed that nurses and physicians providing NIV and chest physiotherapy, working in contact with an infected patient, should have a higher level of respiratory protection [9]. Reports have demonstrated that the use of various facial masks for NIV is associated with substantial exposure to exhaled air leaking within 1 m from the patient. This risk varies according to the type of mask and is greater with increasing leakage and with higher inspiratory pressures [10].

Conclusion

There is limited knowledge about the role of the location outside the ICU (or RIICU) for NIV management of ARF due to high-risk infections. The patient’s clinical status, location, and available equipment must be carefully evaluated before discharging him or her from the safety of the ICU. On the other end, during an era of resource restriction the choice of a less safe environment for NIV treatment might be considered “better than nothing.”

Key Major Recommendations

- The use of NIV should be encouraged whenever appropriate because it is associated with lower rates of nosocomial infection.
- Noninvasive ventilation should not be considered an alternative to ETI for patients with ARF secondary to H1N1 infection.
- Hypercapnic COPD patients with ARF due to infection can be treated in the general ward provided isolation is not necessary and the staff has adequate expertise.
- Hypoxemic ARF should be treated at least in an RIICU where monitoring and immediate endotracheal intubation are available to avoid dangerous delays in care.
- Risk factors for patients in NIV include the ventilator, the humidifier, and their circuits.

References

1. Ambrosino N, Vagheggini G. Noninvasive positive pressure ventilation in the acute care setting: where are we? Eur Respir J. 2008;31:874–86.
2. Chiumello D, Conti G, Foti G, Matteo MG, Braschi A, Iapichino G. Non-invasive ventilation outside the intensive care unit for acute respiratory failure. Minerva Anestesiol. 2009;75:459–66.
3. Corrado A, Roussos C, Ambrosino N, Confalonieri M, Cuvelier A, Elliot M, et al. Respiratory intermediate care units: a European survey European Respiratory Society Task Force on epidemiology of respiratory intermediate care. Eur Respir J. 2002;20:1343–50.
4. Plant PK, Owen JL, Elliot MW. Early use of non-invasive ventilation for acute exacerbations of chronic obstructive pulmonary disease on general respiratory wards: a multicenter randomized controlled trial. Lancet. 2000;355:1931–5.
5. American Thoracic Society. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. Am J Respir Crit Care Med. 2005;171:388–416.

6. Conti G, Larsson A, Nava S, Navales P. On the role of non-invasive (NIV) to treat patients during the H1N1 influenza pandemic. 2009. http://dev.ersnet.org/uploads/Document/63/WEB_CHEMIN_5410_1258624143.pdf.

7. Carlucci A, Delmastro M, Rubini F, Fracchia C, Nava S. Changes in the practice of non-invasive ventilation in treating COPD patients over 8 years. Intensive Care Med. 2003;29:519–25.

8. Rello J, Torres A, Ricart M, Valles J, Gonzalez J, Artigas A, Rodriguez-Roisin R. Ventilator-associated pneumonia by Staphylococcus aureus: comparison of methicillin-resistant and methicillin-sensitive episodes. Am J Respir Crit Care Med. 1994;150:1545–9.

9. Simonds AK, Hanak A, Chatwin M, Morrell M, Hall A, Parker KH, Siggers JH, Dickinson RJ. Evaluation of droplet dispersion during non-invasive ventilation, oxygen therapy, nebuliser treatment and chest physiotherapy in clinical practice: implications for management of pandemic influenza and other airborne infections. Health Technol Assess. 2010;14:131–72.

10. Cheung TMT, Yam LYC, So LKY, Lau ACW, Poon E, Kong BMH, Yung RWH. Effectiveness of noninvasive positive pressure ventilation in the treatment of acute respiratory failure in severe acute respiratory syndrome. Chest. 2004;126:845–50.