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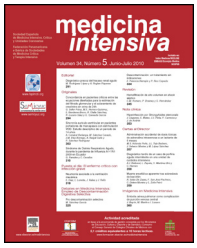

UPDATE IN INTENSIVE CARE MEDICINE: MECHANICAL VENTILATION

Noninvasive mechanical ventilation in chronic obstructive pulmonary disease and in acute cardiogenic pulmonary edema☆

G. Rialp Cervera*, A. del Castillo Blanco, O. Pérez Aizcorreta, L. Parra Morais, on behalf of the GT-IRA of the SEMICYUC

Servicio de Medicina Intensiva, Hospital Son Llàtzer, Palma de Mallorca, Illes Balears, Spain

KEYWORDS
Chronic obstructive pulmonary disease;
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Noninvasive positive-pressure ventilation;
Continuous positive airway pressure;
Mortality;
Intubation;
Treatment outcome;
Review

Abstract Noninvasive ventilation (NIV) with conventional therapy improves the outcome of patients with acute respiratory failure due to hypercapnic decompensation of chronic obstructive pulmonary disease (COPD) or acute cardiogenic pulmonary edema (ACPE). This review summarizes the main effects of NIV in these pathologies. In COPD, NIV improves gas exchange and symptoms, reducing the need for endotracheal intubation, hospital mortality and hospital stay compared with conventional oxygen therapy. NIV may also avoid reintubation and may decrease the length of invasive mechanical ventilation. In ACPE, NIV accelerates the remission of symptoms and the normalization of blood gas parameters, reduces the need for endotracheal intubation, and is associated with a trend toward lesser mortality, without increasing the incidence of myocardial infarction. The ventilation modality used in ACPE does not affect patient prognosis.
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PALABRAS CLAVE
Enfermedad pulmonar obstructiva crónica;
Insuficiencia cardiaca congestiva;
Ventilación no invasiva con presión positiva;
Presión positiva continua de aire;

Ventilación mecánica no invasiva en la enfermedad pulmonar obstructiva crónica y en el edema agudo de pulmón cardiogénico

Resumen La ventilación no invasiva (VNI) junto con el tratamiento convencional mejora la evolución de los pacientes con insuficiencia respiratoria aguda por descompensación hipercápnica de la enfermedad pulmonar obstructiva crónica (EPOC) o por edema agudo de pulmón cardiogénico (EAPC). Esta revisión resume los principales efectos de la VNI en dichas enfermedades. En la EPOC la VNI mejora el intercambio de gases y la clínica, reduce la necesidad de intubación endotraqueal, la mortalidad hospitalaria y la estancia hospitalaria en comparación con la oxigenoterapia convencional. Además, puede evitar la reintubación y disminuir el tiempo de ventilación mecánica invasiva. En el EAPC el tratamiento con VNI acelera la remisión de los

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* Corresponding author.
E-mail address: grialp@gmail.com (G. Rialp Cervera).

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Mortalidad;
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Revisión

síntomas y la normalización gasométrica, reduce la necesidad de intubación endotraqueal y se asocia a una tendencia a menor mortalidad sin aumentar la incidencia de infarto de miocardio. La modalidad ventilatoria utilizada en el EAPC no afecta el pronóstico de los pacientes.
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Introduction

Since its introduction in the 1980s, the use of noninvasive ventilation (NIV) in patients with acute respiratory failure (ARF) has gradually increased as an alternative to endotracheal intubation in the Intensive Care Unit (ICU).[1–3] According to some reports, the use of NIV has actually doubled over a period of 7 years.[1,3] NIV is employed in 11–23% of all the ventilated patients,[1,3,4] which means an 8–13% utilization rate among all patients admitted to the ICU.[1,3,4]

Noninvasive ventilation is regarded as the first choice management along with conventional treatment in hypercapnic ARF in the context of chronic obstructive pulmonary disease (COPD) and in ARF related to acute cardiogenic pulmonary edema (ACPE) or immune depression, in the absence of contraindications. It is important to underscore that NIV failure potentially may be associated with prolonged invasive mechanical ventilation[5] and an increased mortality rate. In this context, mortality rates of over 45% have been reported in non-selected patient populations.[1] Correct patient selection for the use of NIV is essential, since use of the technique is not intended to delay endotracheal intubation but to avoid it.

The present review focuses on the application of NIV in two very prevalent types of ARF in our setting, and in which NIV has shown clear benefits, i.e., in patients with COPD and patients with ACPE.

The present review uses the term NIV in reference to any type of noninvasive ventilatory assistance, whether inspiratory, expiratory or both, and including continuous positive airway pressure (CPAP) for the application of positive end-expiratory pressure (PEEP) in a noninvasive manner (using a mask with its own CPAP system or connected to MV) and noninvasive positive pressure ventilation (NIPPV) for the application of NIV with inspiratory support (pressure support, proportional assist ventilation (PAV), BiPAP, PS S/T, etc.) with or without PEEP.

Use of noninvasive ventilation in patients with chronic obstructive pulmonary disease

Epidemiology

Chronic obstructive pulmonary disease is associated with important morbidity–mortality and affects up to 10% of the Spanish population according to the EPI-SCAN study.[6] The exacerbation of COPD is the cause of 20% of all emergency care consultations, and it is estimated that about 25% of the affected patients present acidosis upon arrival. Management of the exacerbations is based on drug treatment and ventilatory support. Evidence of the benefits of NIV in hypercapnic ARF among patients with COPD has been widely documented in the scientific literature, and the technique is warranted both by a high degree of recommendation in the different clinical guides[7] and by the progressive increase in its use by specialists in recent years. A registry of hospitals in the United States during the period 1998–2008 referred to the use of MV in patients with COPD exacerbation revealed a progressive 462% increase in the use of NIV over the years (from 1% to 4.5% of all admissions), together with a 42% decrease in the use of invasive MV (from 6% to 3.5% of all admissions).[8] In Europe, during the year 2008 a study on the use of NIV found the management of hypercapnic ARF to be the main indication of the technique (48% of the cases).[9]

Physiopathological effects

Chronic obstructive pulmonary disease exacerbation is characterized by an increase in mechanical loading due to the high airflow resistances and dynamic hyperinsufflation which initially give rise to an increase in respiratory effort and intrinsic PEEP. In later stages the condition evolves toward muscle fatigue and consequent clinical and blood gas deterioration. Dynamic hyperinsufflation occurs because of an expiratory time that is too short to reach the resting volume of the respiratory system, and increases with each successive respiration. Under these circumstances, NIPPV has beneficial effects, which will be summarized below and are represented in Fig. 1. On one hand, application of a positive inspiratory pressure reduces respiratory labor with an increase in alveolar ventilation and a lowering of the respiratory frequency–this in turn produces a prolongation of the expiratory time with lesser air trapping. In relation to gas exchange, and due to the increase in minute volume, we observe a lowering of $PaCO_2$ and an increase in pH. On the other hand, the application of external PEEP counters the inspiratory effort needed to surpass the intrinsic PEEP due to the dynamic hyperinsufflation and which can originate up to 60% of the increase in respiratory effort–thereby reducing muscle work. Fig. 2 proposes an interventional algorithm for patients presenting COPD with hypercapnic ARF.

Clinical effects

Hypercapnic ARF in patients with COPD is the main indication of NIPPV–the first studies having been published over two decades ago.[10]

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