

C Damas<sup>2</sup>  
C Andrade<sup>1</sup>  
JP Araújo<sup>1</sup>  
J Almeida<sup>1</sup>  
P Bettencourt<sup>1</sup>

## Desmame de ventilação não invasiva: Experiência com períodos de descontinuação

### *Weaning from non-invasive positive pressure ventilation: Experience with progressive periods of withdraw*

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#### Resumo

**Introdução:** Nos últimos anos, a ventilação não invasiva (VNI) tornou-se numa opção terapêutica válida nas exacerbações agudas de doentes com doença pulmonar crónica obstrutiva. No entanto, apesar de muito utilizada, existe muito pouca informação sobre o desmame deste modo ventilatório. **Objetivos:** Descrever um protocolo de desmame baseado em períodos progressivos de descontinuação de VNI. **Métodos:** Durante um ano foram admitidos 78 doentes na nossa unidade para início de VNI devido a exacerbações agudas de doentes com doença pulmonar crónica obstrutiva. O desmame de VNI era considerado em doentes que se apresentavam sem acidose e com frequência respiratória inferior a 25 ciclos por

#### Abstract

**Background:** In recent years non-invasive ventilation (NIV) has become a valuable therapeutic option in exacerbations of patients with chronic pulmonary obstructive disease. Although widely used there is a paucity of information on weaning from NIV. **Objectives:** We aimed to describe the performance of a weaning protocol based on progressive periods of NIV withdraw. **Methods:** During a one year period we performed NIV in 78 patients with acute exacerbation of chronic respiratory failure. Weaning was considered in patients with 24 hours without acidosis and respiratory rate less than 25 cycles per minute. Weaning was performed as

<sup>1</sup> Serviço de Medicina Interna do Hospital de São João, Porto

<sup>2</sup> Serviço de Pneumologia do Hospital de São João, Porto  
Unidade I&D Cardiovascular do Porto  
Faculdade de Medicina da Universidade do Porto

**Endereço:** Carla Damas  
Serviço de Pneumologia  
Hospital S. João  
Alameda Hernâni Monteiro  
Porto, Portugal  
email:cdamas@aeiou.pt  
phone: 0035191888884

minuto. O desmame era realizado da seguinte forma: Durante as primeiras 24 horas, em cada 3 horas de período diurno o doente estava sem VNI durante uma hora (excepto à noite); no segundo dia, em cada 3 horas o doente estava sem VNI durante 2 horas (excepto à noite), e no terceiro dia a VNI era utilizada apenas em período nocturno. **Resultados:** Sessenta doentes iniciaram o protocolo de desmame. O tempo médio de VNI foi de 120,9 horas (17 a 192 horas). Não houve registo de complicações nos doentes que iniciaram este protocolo. Todos completaram o protocolo sem necessidade de reinstituir VNI ou ventilação invasiva durante o internamento. **Conclusões:** Descrevemos uma taxa excelente de sucesso de desmame de VNI em doentes com exacerbações agudas de doentes com insuficiência respiratória crónica. Apesar de este protocolo implicar uma duração de 72 horas, os resultados sugerem que estratégias baseadas em períodos com e sem VNI são eficazes. No entanto, estratégias menos demoradas merecem investigação.

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**Palavras-chave:** Ventilação não invasiva, insuficiência respiratória crónica, desmame.

following: during the first 24 hours in each 3 hours, one hour without NIV (except during night period), in the second day in each 3 hours, two hours without NIV (except during night period) and in the third day NIV was used during the night period. **Results:** Sixty five patients began the weaning protocol. Mean NIV time was 120,9 hours (17 to 192 hours). No adverse effects were recorded in patients who began the weaning protocol. All patients completed the weaning protocol with no re-institution of NIV or invasive ventilation during hospitalization. **Conclusions:** We report an excellent weaning success rate of NIV in patients with acute severe exacerbation of CRF. Although our weaning protocol required 72 hours, our results suggest that strategies based on periods with and with-out NIV are effective. Weather similar less time consuming weaning strategies are effective, merits investigation.

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**Key-words:** Non-invasive ventilation, chronic respiratory failure, weaning

### Introduction

Non-invasive ventilation (NIV) has become a valuable therapeutic option in patients with severe acute respiratory distress not requiring immediate invasive ventilation. NIV is now widely used in many institutions in patients with acute pulmonary oedema and severe exacerbations of patients with chronic pulmonary obstructive disease (COPD)<sup>1</sup>. This ventilatory technique is associated with clinical improvement, less need of oro-traqueal intubations and less in-

tensive care stay<sup>2-4</sup>. Although the potential clinical application of NIV is still expanding, there is a consensus about using NIV in several clinical situations<sup>2-4</sup>. Success with the use of NIV is now well stabilised although it can be limited by weaning failure requiring a more invasive approach or re-institution of NIV. In fact, there is a paucity of information on weaning strategies from NIV. We aimed to evaluate the performance of a weaning strategies of NIV based on progressive periods of withdraw from NIV.

### Material and methods

During a one year period patients admitted to a High Dependence Unit with acute exacerbations of Chronic Respiratory Failure (CRF) considered to non-invasive ventilation (NIV) were prospectively evaluated. We began NIV (in BiPAP mode) in patients with respiratory acidosis, defined by serum pH under 7.35, despite optimal medical therapy, not considered to immediate invasive ventilation. Patients that did not adapt to a trial of NIV were not included (4 patients).

Weaning was considered in patients presenting simultaneously serum pH equal or superior to 7.35 and a respiratory rate (RR) inferior to 25 cpm for 24 hours. The weaning protocol was based in increasing periods without NIV during a three days period. In day 1, during the day period in each 3 hours one hour was without NIV and two hours with NIV. During the night period, patients were under continuous NIV. In day 2, during the day period during in each 3 hours two hours were without NIV and one hour with NIV, keeping NIV continuously during the night. In day 3, patients were without NIV during the day (only with supplementary oxygen delivered by mask) and with continuous NIV during the night.

### Results

During the study period 78 patients with severe exarcebation of CRF were considered to NIV. Mean age 71.9 years ( $\pm 10.1$ ). Forty five patients were male.

CRF was due to Chronic obstructive pulmonary disease in 80.8% of the patients (n=63), obesity in 23.1% of the patients (n=18), *sequelae* of pulmonary tuberculosis in 14.1% of patients (n=11), sleep apnoea in 5.1% (n=4) and thoracic deformity in 2.6% (n=2) of patients. The causes of exacerbations of CRF were infection in 78.2% of the cases (n=61), non-therapeutic compliance in 10.3% of the cases (n=8) and other causes in 11.6% (n=9). Twenty-nine patients (37.2%) had new infiltrate in the chest x-ray.

Thirty one patients were on long term oxygen therapy and four on home NIV previously to hospitalization.

Of the 78 patients considered to NIV, four did not adapt to this ventilatory technique, two patients began invasive ventilation due to clinical deterioration and seven patients died during the NIV period. Sixty five patients achieved the stability previously required in order to begin weaning from NIV.

Serial arterial blood gases values and RR of patients connected and successful adapted

**Table** – Serial blood gases and serial respiratory rate (RR)

	Admission	First evaluation with NIV (within 3hours)	Before discharge
Ph	7.24 ( $\pm 0.79$ )	7.31 ( $\pm 0.7$ )	7.44 ( $\pm 0.4$ )
PaO2 (mmHg)	75 ( $\pm 32$ )	73.6 ( $\pm 26.9$ )	83.6 ( $\pm 31.6$ )
PaCO2 (mmHg)	85.1 ( $\pm 20.1$ )	76.8 ( $\pm 18.9$ )	59.6 ( $\pm 10.2$ )
HCO3 (mEq/L)	35.7 ( $\pm 7$ )	33.8 ( $\pm 3.5$ )	28.4 ( $\pm 4.3$ )
RR (cpm)	28.3 ( $\pm 8.1$ )	24.7 ( $\pm 7.6$ )	17.3 ( $\pm 3.3$ )

to NIV are presented in the table. Once adapted to NIV, the pressure values that were used to stabilization were mean IPAP -20 mmHg ( $\pm 3$  mmHg) and mean EPAP -6.3 mmHg ( $\pm 1.6$ ). Oxygen was delivered in order to achieve peripheral saturation over 90% (between 6 and 15 litres per minute). All patients were adapted to NIV with facial mask and all were on optimized medical therapy.

NIV was delivered between 17 and 192 hours (mean 120.9 h  $\pm$  60.3 hours). No complications of NIV, namely nasal ulcers or red eye, were recorded. Time with acidosis ranged from 3 to 48 hours. All patients achieve successfully weaning from NIV. Twenty-four hours after the ending of our protocol the patients were discharged from our unit to the nursery. No patient had to be reconnected to NIV or used invasive ventilation during hospitalization

### Discussion

Using NIV in patients with acute exacerbations of CRF is a therapeutic option that is becoming widely used in recent years. This clinical practice is based on several studies comparing NIV with invasive ventilation<sup>5-7</sup>. Although, focusing specially in COPD patients<sup>7</sup>, multiple advantages have been associated with the use of NIV: reduction of the infectious complications related to the ventilator; reduction in airways lesion related to the oro-traqueal tube and reduction of the time of hospitalization as well of the costs<sup>6</sup>. This results and consensus lead to the recommendation of this mode ventilatory model several forms of respiratory failure (chronic or acute)<sup>7,8</sup>. Our results on success of NIV (failure in

16.3% of patients) is similar to other described in the literature, and show that results from clinical trials can be translate to clinical practice<sup>9-14</sup>.

The use of NIV is well described in the weaning of invasive ventilation. Weaning from NIV is an issue with a paucity of information. In the weaning process of NIV, two fundamental approaches could be suggested. One based on progressive periods of withdraw from NIV, other based in a progressive decrease in the inspiratory and expiratory pressures support. Despite these suggestions there is sparse information on weaning success rates provided by different approaches. We describe a weaning strategy, based on increasing periods of NIV withdraw, with an excellent success rate but requiring a 72 hours period of weaning. Our strategy lead to an overall total time of NIV superior to that reported in similar conditions<sup>15</sup>. This aspect is also related to the fact that in a small amount of patients we need to prolong some of the weaning phases (especially phase 2) for more than 24 hours. We did not considered this as a failure in weaning because after this modification in the timing predicted all patients were discharge of our unit with clinical and gasometric improvement. Nevertheless, NIV was well supported and we did not observe any complications or lateral effects associated.

Although interesting, our weaning approach is time consuming, patients had to stay at least three days to finish the weaning process which is an important limitation to its feasibility in clinical practice. Less time consuming programs, based on progressive withdraw from NIV with similar success rate merits investigation.

In summary, we report in a group of patients with exacerbation of respiratory failure requiring NIV, a success of NIV of 83%. In the group of patients with clinical improvement due to NIV a total weaning success based on progressive periods of NIV withdraw was reported.

## Bibliography

1. Barach AL, Martin J, Eckman M. Positive pressure respiration and its application to the treatment of acute pulmonary edema. *Ann Intern Med* 1998; 12:754-95.
2. Mehta S, Hill NS. Noninvasive ventilation. *State of Art. Am J Crit Care Med* 2001; vol 163:540-77.
3. Brochard L, Mancebo J, Wysocki M, Lofaso F, Conti G *et al.* Noninvasive ventilation for acute exacerbations of chronic obstructive pulmonary diseases. *N Engl J Med* 1995; 333:817-22.
4. Lightowler JV, Wedzicha JA, Elliott MW, Ram FS. Non-invasive positive pressure ventilation to treat respiratory failure resulting from exacerbations of chronic obstructive pulmonary disease: Cochrane systematic review and meta-analysis. *BMJ* 2003; 326(7382):185.
5. Kramer N, Meyer TJ, Meharg J, *et al.* Randomized, prospective trial of non-invasive positive pressure ventilation in acute respiratory failure. *Am J Repir Crit Care Med* 1995; 151: 1799-806.
6. 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 multicentre randomised controlled trial. *Lancet* 2000; 355:1931-5.
7. British Thoracic Society. Non-invasive ventilation in acute respiratory failure. *Thorax* 2002; 57:192-211.
8. Liesching T, Kwok H, Hill SN. Acute applications of non-invasive positive pressure ventilation. *Chest* 2003; 124; 699-713.
9. Pingleton SK. Complications of acute respiratory failure. *Am Rev Respir Dis* 1988; 137:1463-93.
10. Thys F, Roeseler J, Reynaert M, Liistro G, Rodenstein DO. Noninvasive ventilation for acute respiratory failure: a prospective randomised placebo-controlled trial. *Eur Respir J* 2002; 20:545-55.
11. Ambrosino N, Foglio K, Rubini F, *et al.* Non invasive mechanical ventilation in acute respiratory failure due to chronic obstructive pulmonary disease: correlates for success. *Thorax* 1995; 50:755-7.
12. Poponick JM, Renston JP, Bennett RP, *et al.* Use of a ventilatory support system (BiPAP) for acute respiratory failure in the emergency department. *Chest* 1999; 116:166-71.
13. Confalonieri M, Garuti G, Cattaruzza MS, Osborn JE, Antonelli M, *et al.* A chart of failure risk for non-invasive ventilation inpatients with COPD exacerbation. *Eur Respir J* 2005; 25: 348-55.
14. Diaz GG, Alcaraz AC, Talavera JC, Pérez PJ, *et al.* Noninvasive ventilation to treat Hypercapnic coma secondary to respiratory failure. *Chest* 2005; 127:952-60.
15. Celikel T, Sungur M, Ceyhan B, Karakurt S. Comparison of non-invasive positive pressure ventilation with standard medical therapy in hypercapnic acute respiratory failure. *Chest* 1998; 114:1636.