Original Article

Non-invasive Ventilation in an Elderly Population Admitted to a Respiratory Monitoring Unit: Causes, Complications and One-year Evolution

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A R T I C L E   I N F O

Article history:
Received 3 February 2012
Accepted 3 May 2012
Available online 1 September 2012

Keywords:
Elderly
Non-invasive mechanical ventilation
Chronic obstructive pulmonary disease
Heart failure
Respiratory Monitoring Unit

A B S T R A C T

Objective: To determine the usefulness of NIV in elderly patients (≥75) admitted to a Respiratory Monitoring Unit (RMU) during hospitalization and 1 year later in comparison with the results from the younger age group (<75).

Materials and methods: Ours is a prospective observational study carried out at the Hospital Universitario La Princesa (Madrid). We recruited all patients who were ≥75 years old and were admitted to our RMU during the period 2008–2009 with respiratory acidosis (pH<7.35 and PaCO2>45mmHg) requiring NIV. We gathered data for basic variables as well as sociodemographics, history of previous pathologies, reason for hospitalization and severity, analysis upon admission and the evolution of blood gases at the start of NIV (within the first hour and after 24h), complications and evolution at the 1-year follow-up.

Results: Mean age of the sample was 80.6. The Charlson index was 3.27. About half of the patients had some limitation for performing daily activities. The main reasons for admission were chronic obstructive pulmonary disease (COPD) exacerbation and heart failure (HF). There were complications in 36% of the cases (11 renal failure and 6 atrial fibrillation). The survival rate at the 1-year follow-up was 63.21%.

Conclusions: NIV is a good alternative in elderly patients admitted to the hospital with respiratory acidosis. We did not detect differences in mortality during admission between the 2 groups. The elderly patients were more frequently re-admitted than the younger group in the 6–12 months after hospital discharge. This could be due to their poorer functional state after hospitalization requiring NIV.

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Ventilación mecánica no invasiva en una población anciana que ingresa en una unidad de monitorización respiratoria: causas, complicaciones y evolución al año de seguimiento

R E S U M E N

Objetivo: Determinar la utilidad de la ventilación mecánica no invasiva (VMNI) en pacientes ancianos (≥75 años) que ingresan en una unidad de monitorización respiratoria (UMR) durante el ingreso y al año del alta. Comparamos los resultados con el grupo de pacientes de menor edad (<75 años).

Material y métodos: Estudio prospectivo observacional realizado en el Hospital La Princesa (Madrid, España). Se reclutaron todos los pacientes ≥75 años que ingresaron en nuestra UMR en acidosis respiratoria (pH <7.35 y PaCO2 >45 mmHg) y que recibieron tratamiento con VMNI. Se recogieron variables relativas a características sociodemográficas y de la vida basal, antecedentes patológicos previos, motivos de ingreso y gravedad, datos análiticos al ingreso y evolución gasométrica al inicio de la VMNI, en la primera hora y tras 24 h, complicaciones y evolución al año de seguimiento.

Resultados: La edad media fue de 80,6 años. El índice de Charlson fue de 3,27. Aproximadamente la mitad de los pacientes presentaban alguna limitación para las actividades de la vida diaria. Los principales motivos de ingreso fueron la agudización de la EPOC y la insuficiencia cardíaca. En 36 casos se registraron complicaciones (11 insuficiencia renal, 6 fibrilación auricular). La supervivencia al año del seguimiento fue del 63,21%.

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Introducción

Con el envejecimiento progresivo de la población, estamos tratando a ancianos con un número mayor de comorbilidades y limitaciones en sus vidas diarias. Se estima que de la población 2020, 48% de los pacientes tendrá al menos una enfermedad crónica y 25% tendrá algún tipo de asociación comorbilidad.1 El mayor número de comorbilidades es principalmente encontrado en el grupo de 65 años.

Esta nueva situación nos lleva a reconsiderar el manejo de ancianos con peor situación de salud que no son candidatos para medidas terapéuticas agresivas, como intubación traqueal, quienes acaban en la sala de emergencia con insuficiencia respiratoria (RF).

En este sentido, nos sentimos que la ventilación no invasiva (NIMV) desempeña un papel crucial en el tratamiento de RF en estos pacientes. Aunque la eficacia de NIMV ha sido demostrada en casos de exacerbación de COPD con hipercapnia RF (es decir, la principal indicación de NIMV en unidades intermedias de cuidados intensivos (RICU)1), alto riesgo de edema, neumonía en pacientes inmunodeprimidos o para intubación no se aplica,4 su indicación en pacientes con “no intubable” es de mayor controversia, especialmente en grupos de ancianos.

Recientemente, articulados con el uso de NIMV en los pacientes mayores han aparecido en observaciones en unidades de cuidados intensivos (RICU) y por grupos internacionales. No hay publicaciones que muestren la necesidad de NIMV en nuestro país en nuestra población que no han sido realizados en un RICU, a pesar de que la utilización de ventilación mecánica no invasiva (NIMV) es más a menudo utilizado para mantener la intubación con intención de extubación.5 La intubación de aparato de extubación en casos de “Do Not Intubate” puede ser una alternativa útil para la calidad de vida de los pacientes y para la salud general.

El objetivo de nuestro estudio fue determinar la capacidad de NIMV en situaciones de salud aguda en pacientes mayores que se encuentran hospitalizados en la sala de respiración aguda (RMU) por insuficiencia respiratoria, y comparar el resultado con pacientes de edades más jóvenes y resultados del seguimiento de 1 año.

Materiales y Métodos

Diseño del estudio

Un estudio prospectivo observacional fue realizado en el RMU del Hospital Universitario de La Princesa (HULP) durante el primer año de actividad (2008-2009). HULP es un hospital terciario en Madrid que provee cuidado a una población de aproximadamente 350 000 habitantes. Nuestro RMU tiene 4 camas y se integra en la pulmonología del hospital. En esta unidad no existe monitorización de los parámetros hemodinámicos (establecimiento de presión arterial, frecuencia cardíaca, frecuencia respiratoria, saturación de oxígeno y electrocardiograma) y la ventilación mecánica no invasiva con NIMV por alteración mecánica en pacientes intubados. La unidad de cuidados intensivos tiene personal de enfermería y una pulmonólogo en tiempo completo. Los pacientes que se encuentran supervisados en el RMU son únicamente en el caso de que estén bajo el control del pulmonólogo.

Población del estudio

Todos los pacientes mayores de 65 años fueron consecutivamente seleccionados para este estudio—este rango de edad fue definido por la Organización Mundial de la Salud (OMS) en los pacientes mayores de 65 años, que fue admitido en el RMU por enfermedad respiratoria (pH<7.35 y PaCO₂>45 mmHg) y necesitó NIMV. El número total de pacientes seleccionados fue 85. Excluyeron de la evaluación a aquellos pacientes que fueron hospitalizados en la sala de urgencias y que rechazaron NIMV o no se consideraron como candidatos para NIMV debido a las limitaciones del pulmonólogo, pacientes que requieren intubación de la unidad de cuidados intensivos (RICU) y apósitos realizados en el hospital de día. La comparación con el grupo control no se hizo debido a la escasa disponibilidad de medicamentos en el RMU.

Conclusiones: La VMNI es una buena alternativa en pacientes ancianos que ingresan a consecuencia de hipoxemia respiratoria. No detectamos diferencias en la mortalidad entre el grupo <75 años. Los pacientes mayores de 65 años se ingresan a una hospitalización de 12 meses más tarde, y esto podría deberse a un peor pronóstico funcional tras un ingreso que requiere VMNI.

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The variables collected for study included those related to sociodemographic and baseline characteristics (age, sex, presence of main caretaker, institutionalization, dyspnea according to MRC classification, number of drugs/day, limitations of daily life activities measured with the Barthel test) and previous pathologic history (comorbidities, Charlson index, home oxygen therapy, home nocturnal ventilation, previous hospitalizations, lung function [FEV₁] and echocardiographic data in patients with previous diagnosis for HF). We also recorded the reasons for hospitalization in our RMU and severity (APACHE II), analytical data at the time of hospitalization and blood gas evolution (pH and PaCO₂) at the start of NIMV and then after 1 h and 24 h of NIMV, evolution during hospitalization (need for intubation, complications, days of hospitalization and death) and 1 year after follow-up (number of hospitalizations and cause, need for NIMV and institutionalization in the ICU and death during that period).

During the study period, 13 patients were lost to follow-up, and in these cases the patients were contacted by telephone in order to collect information related with the study variables. Information was obtained for 100% of the sample, with no losses registered during the follow-up for causes other than the death of the patient.

Statistical Analysis

In the descriptive analysis, means, range (maximum and minimum) and standard deviation (SD) were used for the quantitative variables, while the qualitative variables were expressed as frequencies and percentages. In order to measure the association between the independent qualitative variables, the Student’s t test was used, while for the qualitative variables the chi-squared test was used. With contingency tables, we obtained the correlation between 2 qualitative variables and relative risk. The level of significance was assumed with P<0.05.

The statistical analysis was carried out with the version 15.0 SPSS program for Windows.

Resultados

85 pacientes fueron incluidos para el estudio, 43 (50.6%) de ellos eran mujeres. La edad media fue 80.6 años (SD 5.93), con una edad máxima de 92.

Para la presentación de datos de base se recogieron (ability to perform activities of daily living, main caretaker, polypharmacy, degree of dyspnea according to the MRC scale and institutionalization), which are shown in Figs. 1 and 2 and in Table 1. The Barthel index score was 88.19 (moderate dependence).
Out of the total sample, 49 patients (57.5%) had a previous COPD diagnosis, with a mean FEV1 (% of predicted) of 39.69% (SD, 12.93%). 42.4% (35 patients) belonged to groups III and IV from the GOLD classification.

51.9% (44 patients) had a previous diagnosis of HF. Mean left ventricular ejection fraction, measured by echocardiogram, was 55.06%. The main causes of HF were diastolic dysfunction (14 patients) and cor pulmonale (12 patients), which represented 60% of the etiologies. In our series, 15 patients (17.5%) were diagnosed with sleep apnea–hypopnea syndrome (SAHS) and 11 patients (12.9%) presented the effects of tuberculosis.

With regard to respiratory therapies, 44 patients (51.8%) had prescribed long-term oxygen therapy (LTOT) and 8 nocturnal ventilation with bilevel pressure system (BPAP) and 2 with continuous pressure (CPAP).

Table 1
Baseline Life Characteristics (Caretaker, Institutionalized, Dyspnea, Comorbidities, and Drugs/Day) of Our Study Sample.

<table>
<thead>
<tr>
<th></th>
<th>Score</th>
<th>% of the Total</th>
</tr>
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<tbody>
<tr>
<td>Main caretaker</td>
<td>44 patients</td>
<td>51.9</td>
</tr>
<tr>
<td>Institutionalized</td>
<td>6 patients</td>
<td>7.6</td>
</tr>
<tr>
<td>Dyspnea (MRC) grade III–IV</td>
<td>42 patients</td>
<td>49.3</td>
</tr>
<tr>
<td>Drugs/day</td>
<td>7.01 drugs/day</td>
<td></td>
</tr>
<tr>
<td>Comorbidities (Charlson index)</td>
<td>3.27 (mean score)</td>
<td></td>
</tr>
</tbody>
</table>

30.5% of the sample (25 patients) presented at least one previous hospitalization in respiratory acidosis requiring NIMV the year prior to the start of the study.

The reasons for hospitalization in our RMU are shown in Table 2. NIMV was started in 90% of cases in the emergency department, and in the remainder it had been initiated on other hospital floors. In all cases, it was under the direction of the pulmonology department. Severity upon admittance was measured with the APACHE II score, which in our sample was 17.71 (probability of mortality 26.2%). Blood gas data (pH and PaCO2) at the beginning of NIMV, after 1 h and during evolution after 24 h, are shown in Fig. 3.

In the emergency department, 10 patients required vasoactiveamines, while in 7 nitroglycerine was used. In 9 patients, salbutamol was prescribed in continuous perfusion, and in all cases the vasoactive support and salbutamol perfusion were withdrawn in the first 24 h of evolution. At the start of NIMV, hemogram, biochemistry, and C-reactive protein were ordered (data shown in Table 3). There was rejection in 5 patients due to caustiophoria, while the rest tolerated NIMV without registering any other withdrawals.

During hospitalization, 3 patients were transferred to the ICU and intubated. Complications were recorded in 36 patients, the
most frequent being acute renal failure (11 patients), atrial fibrillation (6 patients), acute lung edema (3 patients), nosocomial pneumonia, and hemoptysis (2 patients). Mean hospital stay was 9.26 days; the death rate was 21.2% (18 patients).

When discharged from the hospital, 43 patients were prescribed LTOT (50.6%), BPAP was prescribed for 24 patients, and CPAP was prescribed for 1. Patients with LTOT at discharge presented increased relative risk for mortality within the first year of 2.2.

In this same period, 21 patients under the age of 75 were admitted to the RMU. We recorded the same data for them as in the over-75 group and these data were compared with the group of older patients (Table 4).

The patients were followed up for 1 year after discharge. This period was divided into 4 stages: from the discharge until the first month (stage 1), from the first month until the third (stage 2), from the third until the sixth (stage 3) and from the sixth until the first year (stage 4). During this period, we recorded the number of visits to the emergency department, hospitalizations and their causes, need for NIMV, admittance to the ICU, intubations, and deaths (Fig. 4). In 13 patients, no clinical data were detected during the follow-up on the electronic medical files, and they were contacted by phone. Out of these 13 patients, 7 had died during the follow-up period.

Discussion

This is the first study done in a RMU that attempts to answer questions about the indication of NIMV in elderly patients. This group of patients constitutes 21% of the total number of visits to emergency, and RF is one of the main reasons for consultation. According to the EPIDASA study, the causes of RF in the elderly are multifactorial. With our data, the main causes of RF were COPD exacerbation (36.5%), followed by HF (31.8%), restrictive ribcage pathology, and obesity-hypoventilation syndrome.

The mean age of our cohort was 80.6. 70% of the patients presented limitations for performing activities of daily living to a greater or lesser degree, and 51.9% needed a caretaker. 65% of the patients were considered to have criteria for no intubation and were not candidates for the ICU. In all cases, NIMV was initiated by the pulmonology department (90% of cases in the emergency department) and the patients were transferred to the RMU. In 3 cases, NIMV failed and the patients had to be intubated. In the study by Nava in patients over the age of 75, 7.3% of the patients with RF and need for NIMV had to be intubated, versus 65% of the group with medication.

This study, done in an ICU, demonstrates that NIMV patients improved their gasometric data and dyspnea more quickly than the patients who received treatment with medication.

In our study, we did not use a control group of patients treated with medication, but when we compared the data with the younger patients, we did not detect statistically significant differences in the gasometric evolution with recuperation of the parameters in the first 24 h (pH 24 h in elderly 7.33 vs. 7.36). Nonetheless, we did detect differences in the evolution of PaCO2 (PaCO2 in elderly 64.47 vs. 57.76 mmHg in the younger age group 24 h after the start of NIMV), probably because the patients in the older age group were more often admitted for HF (31.8% vs. 8.7%) with slower gasometric resolution, and also due to the biology of elderly patients. The overall mortality of the series upon admittance was 21.2% (21.7% in the younger age group). In another study, published by the Scarpazza group, mortality was 13%. In this study, the main cause for admittance was COPD exacerbation and no patients with HF were recruited, which represents the most common cause of mortality in our series and could explain the differences in the percentage of deaths in both groups. After hospitalization for HF, long-term survival was around 30% for 6 years, with a mean survival of 1.7 years in men and 3.2 years in women. In the study by Scarpazza, 1-year survival was 69%, which is similar to our data (63.2%).

By analyzing the parameters associated with higher mortality in our series, the subgroup of patients with LTOT presented higher RR for mortality upon admittance (RR, 1.311) as well as during follow-up (RR 2.0, 6–12 months after hospitalization). Other variables were lower pH (7.19 vs 7.249), higher PaCO2 (88.40 vs 75.50), higher APACHE II score (21.20 vs 18.90) or the Barthel index (75 vs 91). These data are related with the results of the Scarpazza group, where detected factors for prognosis included: lower pH, higher PaCO2, greater number of comorbidities, greater score on the APACHE II index and a lower Glasgow. In other studies, age is an independent factor for NIMV failure, although according to our data we considered the baseline situation and the gasometric data to be better predictors for NIMV failure because, when comparing the NIMV results between the groups over and under the age of 75, we detected no differences in the mortality or in gasometric correction. It is true, however, that the patients who died in the over-75 group had a mean age of 82.17, compared with 79.87 in the group of patients who survived, without there being any statistical significance.

Table 4

Comparison of Both Age Groups (Under 75 and Over 75).

<table>
<thead>
<tr>
<th></th>
<th>&lt;75 Group (SD)</th>
<th>&gt;75 Group (SD)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, yrs</td>
<td>59.70 (9.45)</td>
<td>80.21 (15.84)</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Females, n (%)</td>
<td>8 (34.8%)</td>
<td>43 (50.6%)</td>
<td>ns</td>
</tr>
<tr>
<td>FEV1, % predicted</td>
<td>66 (5.68)</td>
<td>55.65 (14.81)</td>
<td>ns</td>
</tr>
<tr>
<td>Previous LTOT, n (%)</td>
<td>10 (43.5%)</td>
<td>43 (31.2%)</td>
<td>ns</td>
</tr>
<tr>
<td>COPD exacerbations, n (%)</td>
<td>15 (65.2%)</td>
<td>31 (37%)</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Heart failure, n (%)</td>
<td>2 (8.7%)</td>
<td>26 (31%)</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Heart rate, bpm</td>
<td>84 (15)</td>
<td>80 (18)</td>
<td>ns</td>
</tr>
<tr>
<td>HR, bpm</td>
<td>84 (15)</td>
<td>80 (18)</td>
<td>ns</td>
</tr>
<tr>
<td>Heart rate, bpm</td>
<td>84 (15)</td>
<td>80 (18)</td>
<td>ns</td>
</tr>
<tr>
<td>HR, bpm</td>
<td>84 (15)</td>
<td>80 (18)</td>
<td>ns</td>
</tr>
<tr>
<td>Lactate, mmol/L</td>
<td>2.2 (1.2)</td>
<td>3.3 (1.5)</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Leucocytes, mm$^3$</td>
<td>13.370 (4.643)</td>
<td>10.650 (3.935)</td>
<td>.033</td>
</tr>
<tr>
<td>ICU hospitalizations, n (%)</td>
<td>3 (1.5%)</td>
<td>3 (1.5%)</td>
<td>ns</td>
</tr>
<tr>
<td>Hospitalization days</td>
<td>10.30 (6.67)</td>
<td>9.27 (5.81)</td>
<td>ns</td>
</tr>
<tr>
<td>Death, n (%)</td>
<td>5 (21.7%)</td>
<td>28 (11.27)</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>LTOT at discharge, n (%)</td>
<td>9 (39.1%)</td>
<td>46 (54.8%)</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>MV at discharge (CPAP/BPAP)</td>
<td>5 (0/5)</td>
<td>28 (1/27)</td>
<td>&lt;.05</td>
</tr>
</tbody>
</table>

SD: standard deviation; ns: not significant.
Fig. 4. Data related to the follow-up of the sample during the year after hospitalization.
When we compared both age groups, we observed that the elderly patients presented a greater tendency toward rehospitalization and need for NIMV in the 6–12 month follow-up. One possible explanation could be a poorer functional situation at discharge, which should determine greater fragility and the tendency toward rehospitalization. However, we have not used any measures to verify the hypothesis, and this could be the object of later studies.

Bulow and Thorsager suggest that more studies should be done in order to measure the quality of life in elderly patients who require NIMV after discharge, because poorer quality of life may be a possible cause for rehospitalization.

The main limitations in our study were: (a) a relatively small number of patients; (b) lack of a control group of elderly patients treated with medication. Although we have referred to the study by Nava done with 2 groups (NIMV vs treatment with medication), this study was done in an ICU and the percentage of intubations was 65% with medication. Therefore, with current scientific knowledge, we do not consider it ethical to not administer NIMV in cases of hypercapnic RF; (c) the group of patients under the age of 75 is less numerous than the over-75 age group, and the causes for hospitalization were different. HF was also more frequent in the elderly group, although when we compared both groups we found that the benefits of NIMV are similar in both groups.

In conclusion, NIMV is an effective alternative in elderly patients. The improvement in gasometric parameters is similar to that of younger patient groups, and we detected no differences in mortality upon admission. It is a well-tolerated technique, and in our series there have been no complications derived from NIMV that required it to be withdrawn, although previously at the beginning of NIMV 5 patients refused to use it due to claustrophobia. The 1-year follow-up results are very satisfactory and similar to the younger group, although we detected a greater number of hospitalizations and need for NIMV as well as greater mortality in the 6–12 months after discharge. We think that this could be explained by a poorer functional situation at the time of discharge, and we believe that more studies should be done in order to try to confirm this fact and thus be able to detect the subgroup of elderly patients who could benefit most from this technique.

**Conflict of Interests**

The authors declare having no conflict of interest.

**References**