OUTCOME OF NON-INVASIVE DOMICILIARY VENTILATION IN THE ELDERLY

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Abstract:

Introduction: The aim of this study was to evaluate the outcome-including long term effects of Non-invasive Domiciliary Ventilation (NIDV) in our elderly patients and to assess what factors were associated with their survival.

Material and methods: Prospective study that included all patients of our Service who started NIDV at 75 years of older (January 2002 - April 2015). Analysis of survival was undertaken using Kaplan-Meier method and Cox regression.

Results: 82 patients were included (72% women, mean age: 79.9 ± 3,7 years). 67% had more than three comorbidities. The most frequent causal diseases were: Obesity hypoventilation syndrome (65,9 %) and restrictive diseases (17,1 %). Significants improvements were obtained in diurnal blood gases at discharge (PaO_2, $PaCO_2$, ph) and in the follow-up ($PaCO_2$) as well as a significant decrease in the number of hospital admissions. The mean compliance was 8.7 ± 3.2 h/day although tolerance at home was considered to be deficient in 50 %. In the end of the follow-up (median 15 months; range 0 - 135) the mortality was 70.7 %. The estimated survival at 1º year, 2 º year and 3 º year was 63 %, 56 % and 44 %, respectively. Survival was independently associated with: good compliance, restrictive disease, lower EPAP level and lower dyspnea level (mMRC) in the follow-up.

Conclusions: The results of the NIDV in elderly patients are satisfactory improving arterial blood gases, hospital readmissions and achieving long survival. Survival was better in "good compliance" patients, in restrictive diseases and with lower dyspnea level at follow up.

Key words: Non-invasive domicilary ventilation; respiratory failure; elderly; survival.

VENTILACIÓN NO INVASIVA DOMICILIARIA EN PACIENTES DE EDAD AVANZADA

Resumen

Introducción: Conocer la evolución a largo plazo de pacientes ancianos en ventilación no invasiva domiciliaria (VNID) y qué factores se asocian a la supervivencia de los mismos.

Material y métodos: Estudio prospectivo de los pacientes >75 años que han iniciado VNID en nuestro centro en un periodo de 12 años (2002 - 2014). Se realizó un análisis univariado (Kaplan-Meier) y multivariante de supervivencia (Cox).

Resultados: Se incluyeron 82 pacientes. Un 67% tenían >3 comorbilidades, iniciándose la ventilación en situaciones agudas en el 76,8%. La patología causal más frecuente fue el síndrome de obesidad-hipoventilación (65,9%) y la patología toracógena (17,1%). Se consiguieron mejorías gasométricas estadísticamente significativas entre el ingreso y alta (PaO_2, $PaCO_2$ y ph) y en el seguimiento ($PaCO_2$), así como una reducción en el número de ingresos posteriores. La media de horas de uso fue de 8,7 ± 3,2 horas/día, pero la tolerancia fue mala en el 50% de los casos. Al final del seguimiento (mediana 15 meses; rango: 3 - 135) la mortalidad fue del 70,7%. La supervivencia al año, 2º año y 3º año fue, respectivaente, del 63%, 56% y 44%. Fueron predictores independientes de supervivencia: la cumplimentación global, la patología toracógena como causa de indicación de VNID, un menor nivel de EPAP y el grado de disnea (mMRC) en el seguimiento.

Conclusiones: Los resultados de la VNID en pacientes ancianos son satisfactorios, consiguiendo mejorías mantenidas en el intercambio gaseoso, reingresos y supervivencias prolongadas. La supervivencia fue superior en los pacientes cumplidores del tratamiento, con patología toracógena y con menor grado de disnea en el seguimiento.

Palabras clave: Ventilación no invasiva domiciliaria, fallo respiratorio, anciano, supervivencia.

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INTRODUCTION

Home non-invasive ventilation (NIV) has been accepted as a treatment for chronic respiratory failure in patients with disorders of the thoracic cage and neuromuscular disease[1-3]. Additionally, in cases of acute respiratory failure, it has proven to be efficacious, reducing the need for endotracheal intubation and mortality. It is the treatment of choice in COPD exacerbations (AECOPD)[4].

In spite of this, its use in elderly patients has been less studied, questioning whether its efficacy is similar to that obtained in younger patients. There are studies that have found highly satisfactory results in elderly patients (>75 years), reducing the need for intubation in this population and showing that it can even be applied in patients with cognitive deterioration[5-6].

It has been suggested that the worse long-term tolerance along with the lower life expectancy in elderly patients could be limiting factors when indicating or maintaining NIV. There are very few studies available that evaluate the evolution and long-term survival of elderly patients treated with home NIV. Survival rates are found to be between 50 and 94%. The majority of these series include few patients, very diverse disease and, in general, short follow-ups[7-12].

The objective of our study has been to evaluate the evolution, both in the short and long term, in a cohort of elderly patients (>75 years) for whom home NIV was prescribed, placing particular emphasis on the indications and condition at the beginning of treatment, tolerance, compliance and long-term survival. In the same way, our aim is to understand what variables are related to long-term evolution in these patients.

MATERIAL AND METHODS

Study design: a prospective descriptive observational study was done in the Pulmonology Department at the Hospital Infanta Cristina, including all of the patients who began home NIV between 2002-2014. The procedure was primarily initiated during conventional hospitalization (95.1%), although two beds have been available since 2009 with continuous non-invasive monitoring, trained nursing staff and an on-duty pulmonologist to assure continuous care.

All patients meeting the following inclusion criteria were selected: beginning NIV within the established period, ≥75 years old, regardless of the reason or condition at the start of treatment (acute respiratory failure, exacerbated chronic respiratory failure or stable chronic respiratory failure) or maintaining the condition after hospitalization. The diagnosis of obesity hypoventilation syndrome was established when BMI was >30 and daytime $PaCO_2$ was >45, once other causes of hypercapnia were excluded. The study followed the ethics standards for our hospital and patients or their relatives signed an informed consent.

Variables related to sociodemographic and clinical characteristics were collected (age, sex, environment of origin [rural/urban], presence and type of comorbidities [atrial fibrillation, presence of radiological or echocardiographic data showing pulmonary hypertension, history of neoplasm, previous diagnosis of sleep apnea syndrome, tuberculosis, hepatopathy, arterial hypertension, cardiopathy, obesity (BMI >30 kg/m^2) and other comorbidities including history of depression], Charlson index, fundamental pathology leading to the start of home NIV, condition at the start of NIV [acute, exacerbated chronic or stable chronic respiratory failure], location where NIV was started, level of consciousness when NIV was started (Glasgow scale), baseline arterial blood gases at the start of hospitalization and before discharge, patient adaptation to NIV at the start of hospitalization and before discharge when treatment was started (subjectively collected based on comfort and the patient's positive acceptance of treatment according to the judgment of the doctor responsible for the procedure), days of hospitalization, need for supplementary oxygen therapy, history of previous hospitalization before starting NIV, total number of previous hospitalizations and those in the year prior to beginning NIV and history of respiratory failure before beginning NIV, IPAP and EPAP pressure prescribed, type of interface (nasal/oronasal), Modified Medical Research Council (MMRC) degree of dyspnea before beginning NIV, FVC (in %), FEV1 (in %) and FEV1% before beginning NIV (recorded the year before and in stable condition) and the presence of chronic obstructive pulmonary disease [COPD])[13].

Follow-up: all patients were prospectively monitored at a non-invasive ventilation specialized consultation unit every 3 months. During monitoring, the following variables were collected: baseline arterial blood gas under clinical stability, treatment tolerance according to judgment of

the doctor responsible (considered poor if the number of hours of daily use was <5 hours/day and/or the patient or their caretaker referred to frequent problems with home NIV related to the subjective feeling of comfort during sleep and side effects related to the device or interface), number of hours of ventilation per day, including the number of daytime and nighttime ventilation hours using a personal interview with the patient and/or caretaker (these results were confirmed by reading the number of hours of use on the ventilator), additional hospitalizations and the date of the first rehospitalization after discharge, the number of rehospitalizations after discharge, the MMRC level of dyspnea after at least three months of home NIV, FVC (in %) and FEV1 (in %) and FEV1% at least three months after starting home NIV in stable condition. Finally, the patient's quality of life was subjectively evaluated according to the judgment of the doctor responsible (good: the patient was completely autonomous at home and could leave without help or with minimal assistance from their caretaker, and bad: non-autonomous patient at home, unable to perform activities outside their home without significant help from their caretaker).

Patients were monitored until June 2015, noting the date of death when applicable. Information was obtained for 100% of patients without registering losses other than death of a patient through the systematic review of the electronic clinical history or phone contact when necessary.

Statistical analysis: a descriptive analysis was done using the average, range, and standard deviation for the quantitative variables, as well as frequencies and percentages for the qualitative variables. The student's t test for independent samples was used to measure the association between quantitative variables and the chi-squared test was used for qualitative variables. The student's t test for related data was used to measure the association between quantitative variables throughout the follow-up period. The level of significance was set as $p < 0.05$.

Mortality tables, the Kaplan-Meier method and the Cox model were used for the univariate survival analysis. For this, the outcome event was defined as a combination of negative results including death, discontinuing home NIV or loss of the patient due to NIV stability. All of the variables that were found to be significant in the univariate analysis ($p < 0.1$) were included in a Cox proportional hazards model to evaluate their contribution with regard to survival.

RESULTS

A total of 82 patients aged 75 or older (24.2% of the total number of patients [338] who began home NIV) were included. The main characteristics of these patients are found in Table 1. The majority were women (72%) with frequent comorbidities, especially of cardiological origin, and with a high prevalence of obesity (66%). A history of previous respiratory failure (65.9%) and previous hospitalizations (76.8%) were frequent.

The diseases leading to starting home NIV are shown in Table 1. The main etiology was obesity hypoventilation syndrome (OHS) in 65.9% and thoracogenic disease. A significant percentage had poor adaptation to the initial NIV (42.7%) or NIV at discharge (31.7%); in spite of this, the doctor responsible chose to prescribe it. The length of hospitalization was an average of 10 days (interquartile range 25 - 75: 7 - 16). Statistically significant improvements were seen in gas status at discharge which continued to improve in outpatient tests in a state of maintained stability (Table 2). In the same way, the number of rehospitalizations and the level of dyspnea significantly decreased after starting home NIV.

The median follow-up for the cohort was 15 months (interquartile range 25 - 75: 3 - 41.2). A significant percentage of patients (50%) showed poor treatment tolerance, in spite of the fact that the average number of hours of daily use was considered good in general. At the end of follow-up, mortality was 70.7% (Table 2). The mortality table method was used to estimate survival at one year, two years and three years as 63%, 56% and 44%, respectively. The median survival was 29.4 months. The survival function and mortality risk shown in the distribution of mortality throughout the follow-up period is included in Figure 1.

Mortality was higher in cases of atrial fibrillation, a higher Charlson index, cases of previous respiratory failure ($p = 0.07$) and a higher number of hospitalizations prior to starting home NIV, as well as cases of poor adaptation to NIV upon hospitalization or at discharge ($p = 0.07$). During follow-up, mortality was higher in patients with rehospitalizations and a higher number of rehospitalizations after starting home NIV, with worse $PaCO_2$ levels, a higher level of dyspnea in follow-up ($p = 0.05$) and, above all, those who had poor treatment tolerance and a poor quality of life (Table 3).

The survival analysis with the Kaplan-Meier method (Figures 2,

3 and 4) showed similar results with a higher mortality in cases with poor adaptation, poor tolerance, and worse quality of life. The type of disease was also associated with survival, as better survival was seen in thoracogenic patients (average survival 73 months; CI 95%; 62.7-83.2), followed by OHS (average survival 34 months; CI 95%: 22.9-45) and the worst was seen in neuromuscular disease (average survival 3 months; CI 95%: 2-5.1).

In the multivariate analysis, survival was associated with good treatment tolerance, thoracogenic disease being the reason for starting home NIV, the need for a lower EPAP level and a lower level of dyspnea in follow-up (Table 4).

Table 1: Clinical characteristics and sociodemographics of the patients included in the study (n = 82)

Age*	79.9 ± 3.7
Male/female (%)	28/72
Rural/urban environment (%)	61/39
Comorbidities (%):	
Depression	36.6
Atrial fibrillation	37.8
Pulmonary hypertension	29.3
Neoplasm	15.9
Obstructive sleep apnea syndrome	39
Residual tuberculosis	4.9
Hepatopathy	3.7
Arterial hypertension	81.7
Cardiopathy	58.5
Obesity (BMI >30)	66
Other comorbidities	76.8
COPD	26.8
>3 comorbidities	67.1
Charlson index*	5.2 ± 1.3
Condition at the start of NIV (%):	
Acute respiratory failure	19.5
Exacerbated chronic respiratory failure	57.3
Stable chronic respiratory failure	23.2
Location NIV was started (%):	
Pulmonology ward	95.1
Elsewhere**	4.9
Level of consciousness at start of NIV (%):	
Glasgow <10	6.1
Glasgow 10-14	26.8
Glasgow >14	67.1
Primary disease leading to start of NIV (%):	
Neuromuscular disease***	6.1
Thoracogenic disease****	17.1
Obesity hypoventilation syndrome	65.9
COPD	11
Interface (%):	
Nasal	56.1
Oronasal	43.9
Previous respiratory failure (%)	65.9
Previous hospitalizations (%)	76.8
Total number of previous hospitalizations*	2.4 ± 2.6
Number of hospitalizations in the last 12 months*	1.3 ± 1.5
Poor initial adaptation to NIV (%)	42.7
Poor adaptation to NIV at discharge (%)	31.7
Need for supplementary oxygen therapy (%)	74.4
IPAP level*	15 ± 2.1
EPAP level*	4.4 ± 0.9

*Average±standard deviation. **Including ICU or the emergency department ***Including 5 cases of amyotrophic lateral sclerosis and 1 of polymyositis ****Including 9 cases of kyphoscoliosis, 4 of fibrothorax and 1 thoracoplasty. COPD: chronic obstructive pulmonary disease. BMI: body mass index. NIV: non-invasive ventilation IPAP (in cm of H_2O): inspiratory positive airway pressure. EPAP: expiratory positive airway pressure.

Table 2. Developmental characteristics in the patients included in the study (n = 82)

Variable	At start of NIV	At discharge	In follow-up
PaO2**	59 ± 16.4	67.2 ± 12.3	65.7 ± 13*
PaCO2**	68 ± 20.2	52.1 ± 9.4	48 ± 9.3*
pH**	7.32 ± 0.09	7.42 ± 0.05	7.39 ± 0.05*
No. of hospitalizations	2.43 ± 2.68	-	1.33 ± 1.98
Dyspnea (MMRC)***	3.8 ± 0.5	-	2.8 ± 0.7*
FVC in %	58.3 ± 20.2	-	59.7 ± 19.2*
FEV1 in %	52.9 ± 20.2	-	57.1 ± 19.4*
FEV1%	73.2 ± 17.4	-	76 ± 12.3*
Home NIV tolerance (%):			
Good	-	-	50
Bad	-	-	50
No. of daily hours of NIV	-	-	8.7 ± 3.2*
No. of daily hours of NIV daytime use	-	-	1.1 ± 2.3*
Rehospitalizations for respiratory failure (%)	-	-	58.5
Quality of life (%):			
Good	-	-	62.2
Bad	-	-	37.8
Status at the end of monitoring (%):			
Stable in home NIV	-	-	29.3
Death	-	-	70.7

*Clinically stable after at least 3 months of home NIV
**p <0.05 in comparisons between admission and discharge, and between discharge and follow-up (except PaO2 and pH)
***p <0.05.

Table 3. Clinical and developmental characteristics of patients according to living situation at the end of follow-up

Variable	Living (n = 24)	Dead (n = 58)	p
Age	79.1 ± 2.8	80.2 ± 4.1	ns
Male/female (%)	37.5/62.5	24.1/75.9	ns
Comorbidities (%):			
Depression	29.2	39.7	ns
Atrial fibrillation	20.8	44.8	0.05
Pulmonary hypertension	29.3	29.2	ns
Neoplasm	12.5	17.2	ns
Obstructive sleep apnea syndrome	37.5	39.5	ns
Residual tuberculosis	0	6.9%	ns
Hepatopathy	5.2	0	ns
Arterial hypertension	87.5	79.3	ns
Cardiopathy	50	62.1	ns
Obesity (BMI >25)	79.2	58.6	ns
Other comorbidities	66.7	81	ns
COPD		27.6	ns
>3 comorbidities	58.3	70.7	ns
Charlson index*		5.4 ± 1.2	0.03
Primary disease leading to start of NIV (%):			
Neuromuscular disease	4.2	6.9	
Thoracogenic disease	25	13.8	ns
Obesity hypoventilation syndrome	62.5	67.2	
COPD	8.3	12.1	
Status at the start of NIV (%):			
Acute or exacerbated chronic respiratory failure	70.8	79.3	ns
Stable chronic respiratory failure	29.2	20.7	
Glasgow <14 at start of NIV (%):	33.4	32.8	ns
Oronasal interface (%):	54.2	39.7	ns

Previous hospitalizations (%)	70.8	79.3	ns
Previous respiratory failure (%)	50	72.4	0.07
Total number of previous hospitalizations*	1.5 ± 1.7	2.81 ± 2.9	0.02
Number of hospitalizations in the last 12 months*	0.92 ± 1.13	1.57 ± 1.7	0.04
Poor initial adaptation to NIV (%)	25	50	0.05
Poor adaptation to NIV at discharge (%)	16.7	37.9	0.07
Need for supplementary oxygen therapy (%)	66.7	77.6	ns
Rehospitalization after starting home NIV	37.5	67.2	0.02
Number of rehospitalizations after starting home NIV	0.67 ± 1.2	1.6 ± 2.1	0.01
PaO2 during follow-up	68.8 ± 10.7	64.5 ± 14.5	ns
PaCO2 during follow-up	45 ± 5.8	49.2 ± 10.2	0.03
pH in follow-up	7.40 ± 0.03	7.39 ± 0.05	ns
Dyspnea prior to starting NIV (MMRC)	4 ± 0	3.7 ± 0.6	ns
Dyspnea in follow-up (MMRC)	2.6 ± 0.4	2.9 ± 0.8	0.05
IPAP level	14.7 ± 1.5	15.1 ± 2.3	ns
Poor home NIV tolerance in follow-up (%)	20.8	62.1	0.001
No. of daily hours of NIV*	8.7 ± 2	8.6 ± 3.6	ns
No. of daily hours of NIV daytime use*	0.8 ± 1.4	1.2 ± 2.7	ns
Quality of life (%):			
Bad	12.5	48.3	0.003
Good	87.5	51.7	

*Average±standard deviation.

Table 4. Variables independently associated with mortality in elderly patients using home NIV*

Variable	P	OR	CI 95%
Good compliance with home NIV	0.02	0.46	0.24 - 0.87
Thoracogenic disease	0.01	0.36	0.16 - 0.82
EPAP level	**0.01**	**1.60**	**1.11 - 2.31**
Developing dyspnea (MMRC)	0.008	2.12	1.22 - 3.69

*Cox proportional hazards model (adjusted for age, Charlson index, EPAP level, number of previous hospitalizations, presence of depression, treatment compliance, initial and hospitalization adaptation, quality of life, presence of thoracogenic disease and level of MMRC dyspnea). Backward stepwise method.

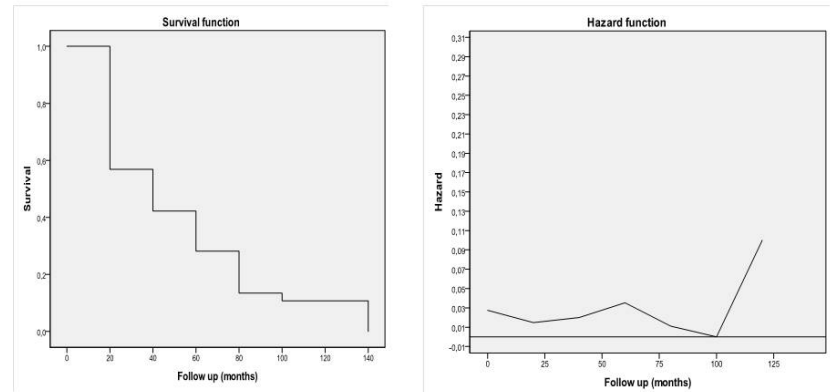

Figure 1: Survival function and mortality risk function (deaths/patient/month) for patients >75 in home NIV (mortality table method).

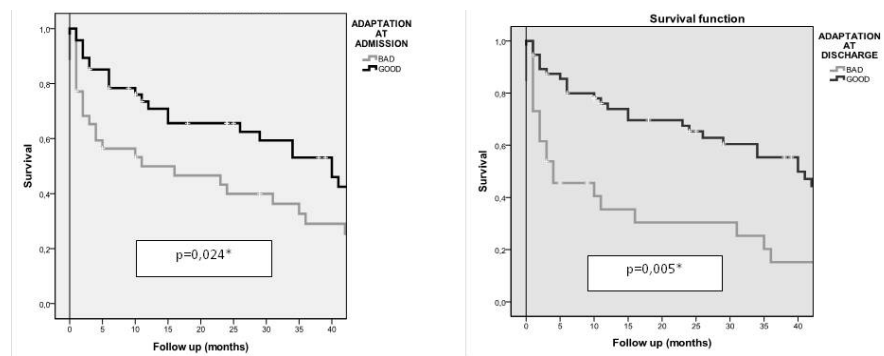

Figure 2: Survival curves for the patients studied according to adaptation to NIV upon hospitalization and at discharge (Kaplan-Meier method). NIV: non-invasive ventilation *Log-rank test.

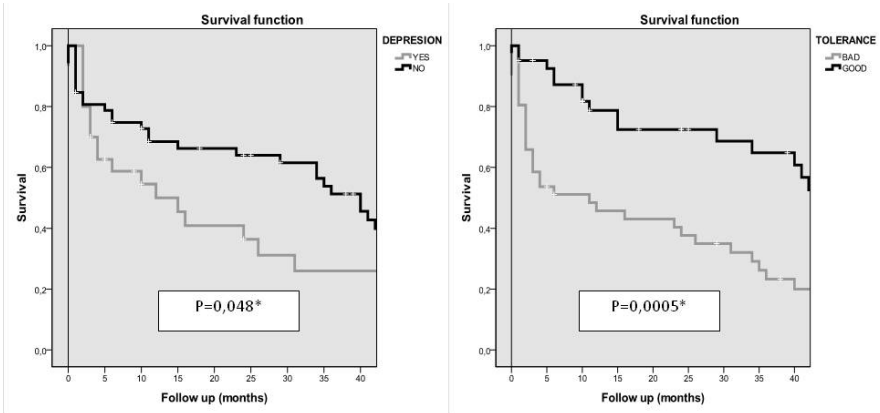

Figure 3: Survival curves for the patients studied according to the presence of depression and tolerance for NIV during follow-up (Kaplan-Meier method). NIV: non-invasive ventilation *Log-rank test.

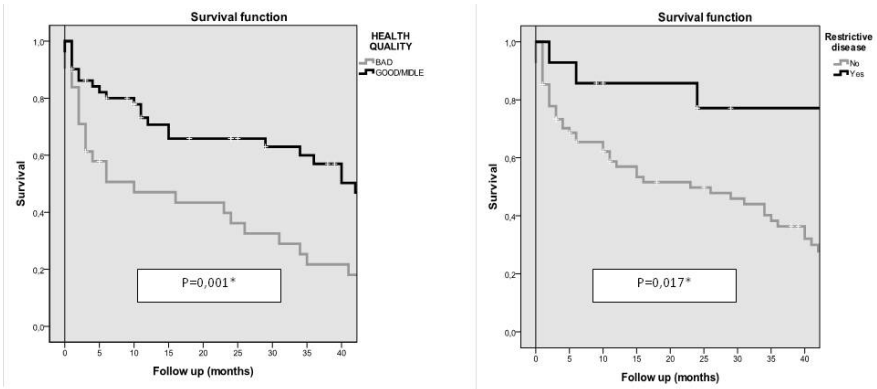

Figure 4. Survival curves for the patients studied according to quality of life and the pathology leading to starting NIV (Kaplan-Meier method). NIV: non-invasive ventilation *Log-rank test.

DISCUSSION

The causes of respiratory failure (RF) in the elderly requiring the start of NIV are multifactorial[14, 15], although the primary causes are COPD, heart failure, thoracogenic disease and OHS[8]. In our case, the main indications for home NIV were OHS (65.9%) and thoracogenic disease (17%), while COPD only represented 11%, although these discrepancies can be attributed to the fact that our study was based on patients included in a home NIV program and did not focus on NIV in acute patients[10, 12].

Many of the studies on NIV in these patients find that, along with age itself, comorbidities and the frequent presence of physical limitations prevent patients from being candidates for endobronchial intubation or ICU admission. In our case, the majority of patients began in a conventional pulmonology ward (95.1%), in spite of the fact that up to 76.8% were in a state of exacerbated RF and 35.9% had a deteriorated level of consciousness.

We found a high frequency of comorbidities (>3 comorbidities: 67.1%, Charlson index: 5.2 ± 1.3), a fact which is often referred to in other work[6, 8]. More important than these facts were the number of patients who had had previous RF (65.9%) or a high number previous hospitalizations (2.4 ± 2.6), which leads us to think that, in many cases, the start of NIV in states of exacerbation is being delayed, estimating a high rate of early lethality. However, there are studies that have compared the efficacy and results of NIV in acute situations, without finding differences with respect to younger patients[8]. In this way, mortality upon discharge in different works has varied from 6% to 45%[5-12, 16-18]. The differences in the results are closely related to the type of study, number of patients, place and methodology used start NIV, RF etiology and the associated comorbidities.

In general, many works support NIV indications in elderly patients with hypercapnic acute respiratory failure secondary to AECOPD, finding an increased efficacy compared to more aggressive measures. They even point out that NIV can be effective in highly incapacitated patients or those with forms of dementia and note that these problems can be controlled in units specifically dedicated to this type of patient (transitional care units or geriatric pulmonology departments) with high success rates and mortality rates comparable to younger subjects. Many of these studies only evaluated the effects of NIV during acute respiratory failure without posterior follow-up. However, the majority agree in affirming that it is a safe procedure with few complications and it improves the short-term evolution of elderly patients in

comparison to the guidelines for conventional treatment[5-12].

NIV in these patients comes with significant problems with adaptation and tolerability. Our results indicate this as up to 31.7% of patients were considered to have poorly adapted at discharge according to the doctor responsible. In other studies, the presence of complete intolerance during hospitalization varies between 6 and 10%[5, 6] and there are no studies that prospectively evaluate this concept in patients over the long term.

We found clear improvements at discharge in gasometric parameters, which were maintained during follow-up, as well as the level of dyspnea and number of hospitalizations after starting home NIV. We concur with other authors[8, 10, 12] in stressing the convenience of maximally optimizing home NIV in order to avoid rehospitalizations that can substantially influence the long-term prognosis of these patients.

In follow-up we saw that the tolerance for home NIV was poor in half of the patients in spite of the fact the average number of hours of daily use was good in general (8.7 ± 3.2 hours/day). Along with the number of hours used, the definition of poor tolerance included aspects related to patient satisfaction, the appearance of side effects related to the interface or discomfort caused by the ventilator and according to the opinion of the patient's caretaker. In the work by Farrero et al.[10], the initial level of tolerance was good, although 11% ended up discontinuing home NIV. This author notes that this percentage is significantly higher than that observed in young patients (4%), but similar to that seen in other studies on patients of any age[19]. One of the facts that can influence these results is the type of disease in which home NIV is indicated, with higher rates of discontinuation in COPD patients for whom there is controversy as to whether to use the treatment during periods of clinical stability. In any case, poor tolerance and discontinuation of home NIV are not identical concepts, although in our opinion the former may be a predictor for the latter.

Some 58.5% of patients were rehospitalized for RF and 37.8% were considered to have a poor quality of life, thus the final mortality in the study was high (70.7%). Works following this patient group are scarce[7-12, 18] and many of them focus on the start of NIV, retrospectively registering the evolution and generally short follow-ups, with a mortality rate ranging from 6 to 51%. Farrero et al.[10] monitored 43 patients for an average of 36 ± 24 months, with a mortality rate of 50%. Other studies followed patients among whom a high percentage do not continue home NIV and found a much higher mortality rate, such as Schortgen et al.[11] (mortality at 6 months: 51%) and Scarpazza et al.[9] (mortality at 3 years: 31% in ventilated patients vs 65.2% in patients with home oxygen therapy). In our case, mortality at one year was 47% and 56% at three years, with an average survival rate of 31.8 months.

We found different variables related to mortality at the end of follow-up, noticing that patients with a higher Charlson index, a higher number of previous hospitalizations or history of RF, without thoracogenic disease, with poor NIV adaptation, with rehospitalizations, with a higher level of dyspnea during follow-up, with poor tolerance and a poor quality of life died more frequently and earlier than the other patients.

Early and correct indication could avoid starting home NIV in more advanced stages of the disease, when its effects may not be as satisfactory. On the other hand, the problem with adaptation and tolerability in these patients must be taken into account, both in the initial phase and during home control, optimizing the means of outpatient support as a way of obtaining long-term satisfactory results. In this sense, the companies supplying home respiratory therapies must play an essential role in the long-term adaptation by coordinating with the medical service prescribing the treatment. In our case, good treatment tolerance was related to a higher survival rate in patients and was one of the variables independently related to this.

Finally, it is necessary to establish some treatment limits in these patients. In this sense, it is necessary to take their quality of life into account, not only as an indicator for long-term vital prognosis, but also as an estimation of the benefits home NIV is providing. Perhaps we should reconsider maintaining NIV over the long term in patients with very advanced disease, poor quality of life and in whom home NIV does not manage to improve certain aspects of their condition (dyspnea, sleep, comfort).

The main limitations of the study stem from the number of patients included, the type of disease in which home NIV was used and including the course of action for a single hospital center. As we have mentioned, the studies available on this type of patient are scarce and, in general, are also monocentric. Other limitations stem from the methodology used in applying NIV. Some works have suggested the vulnerability and frequent complications associated with NIV use in the elderly, recommending administration in departments specifically dedicated to this procedure where there are higher possibilities of success[5, 6, 8, 9, 11].

In spite of this, our results support the use of home NIV in elderly

patients, obtaining sustained improvements in gas exchange, level of dyspnea, rehospitalization and prolonged survival. We would like to highlight that the frequent problems with adaptation and tolerance over the long term must be monitored and corrected as a way of improving treatment results. Finally, we believe it is necessary to evaluate the quality of life in this group of patients, which could be a clear predictor of mortality and, in many cases, a determining factor in prescribing home NIV over the long term.

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