Non-invasive ventilation in the elderly – never too late!

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Dear Editor,

Practising evidence-based medicine in an ageing population is challenging. Nevertheless, using age as a diagnostic or therapeutic procedure contraindication is less and less common. Domiciliary non-invasive ventilation (NIV) in chronic respiratory failure patients has been largely used; however, data from older people is scarce. The latest European Respiratory Society guidelines for long-term home NIV for management of chronic obstructive pulmonary disease (COPD) point out the need for more research in the elderly since the initial trials excluded patients older than 65 and age is no longer a contraindication, but the mean age in trials is around 65 years old. Our centre has a significant proportion of older patients under domiciliary NIV, so we felt the need to share our experience to increase the evidence in the ageing population.

We performed a longitudinal retrospective study of patients with ≥75 years old under NIV in one year in a chronic setting. Patients were adapted in an NIV-lab, using thoracoabdominal bands, peripheral oxygen saturation and transcutaneous carbon dioxide (TcCO2) monitoring. Patients were ambulatory or were already admitted as an inpatient, and home NIV was decided during admission. Evaluation of efficacy and adherence were performed at the first month and one year after. Descriptive data were expressed as frequencies and percentages for qualitative and ordinal variables, and as the mean and standard deviation (SD) for quantitative data. Student's *t*-test or Wilcoxon test were used to comparing quantitative variables and Chi-square test or Fisher exact test to categorical variables (SPSS v. 25.0).

There were 261 in-lab NIV titrations in one year, and 82 (31.4%) performed in patients older than 75 were included in this study. The majority were male (43, 52.4%), with a mean age of 82.1±5 years old. Treatment indications included obstructive sleep apnoea with nocturnal hypoventilation (23, 28%), COPD (17, 20.7%) and obesity hypoventilation syndrome (16, 19.5%). Most patients (72%) presented with hypercapnic respiratory failure, 3.7% were hypoxemic, and 20.4% without respiratory failure. Patients' characteristics and NIV related information are summarised in Table 1.

The adherence at the first month of treatment was adequate and remained (93.4%/days with 7.46 hours/night at first month and 89%/days with 8h16/night at 12 months, p=0.696). Fourteen patients (17.1%) suspended NIV during follow-up (Table 1). One patient under adaptative servo-ventilation had a reduction in left ventricle ejection fraction and, therefore, NIV was discontinued. Patients who suspended NIV due to intolerance or refusal were not ventilated with higher pressures than other patients (mean IPAP 19±4.4 *vs* 19.2±4.7, p=0.905; mean EPAP 7±2.1 *vs* 7.5±2.4, p=0.493; support pressure 12±4.9 *vs* 11.7±4.6, p=0.858) and none was secondary to interface related side effects.

Regarding treatment efficacy, oxygen saturation (SpO_2) increased, and CO_2 arterial pressure ($PaCo_2$) decreased significantly at the end of the first month (SpO_2 90.7±3.9% in the baseline, 94.4±2.9 in the first month, p<0.001; $PaCO_2$ 51.5±8.8 mmHg

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Table 1. Complete cohort characteristics and comparison between patients under and over 85 years of age.

Characteristics	Total patients	<85 years-old	≥85 years-old	p
Sex (n, %)				
Male	43, 52.4%	32, 59.3%	11, 39.3%	0.086*
Female	39, 47.6%	22, 40.7%	17, 60.7%	
Age (mean±SD)	82.1±5.2			
≥75, <85 years old (n, %)	54, 65.9%			
≥ 85 years old (n ,%)	28, 34.1%			
Obesity (n, %)	32, 39%	21, 38%	11, 39%	0.972 *
Heart failure (n, %)	39, 47.6%	24, 44.4%	15, 53.6%	0.433*
NIV indication (n, %)				
OSAS with hypoventilation	23, 28%	16, 29.6%	7, 25%	
COPD	17, 20.7%	13, 24.1%	4, 14.3%	
Overlap COPD-OSAS	16, 19.5%	10, 18.5%	6, 21.4%	0.462*
OHS	16, 19.5%	7, 13.0%	9, 32.1%	
Neuromuscular disease	5, 6.1%	4, 7.4%	1, 3.6%	
Chest-wall disease	4, 4.9%	3, 5.6%	1, 3.6%	
ILD	1, 1.2%	1, 1.8%	0, 0%	
Oxygen (n, %)				
LTOT	24, 29.3%	17, 31.5%	7, 28%	0.330*
AOT	1, 1.2%	0, 0%	1, 3.6%	
NIV adaptation setting (n, %)	18, 22%	11, 20.4%	7, 25%	0.631*
Inpatient/post-exacerbation	64, 78%	43, 79.6%	21, 75%	
Ambulatory				
Mode				
Bilevel ST (n, %)	75, 91.5%	48, 88.9%	27, 96.4%	0.272*
Bilevel S (n, %)	2, 2.4%	2, 3.7%	0, 0%	
Auto-bilevel (n, %)	1, 1.2%	1, 1.8%	0, 0%	
AVAPS (n, %)	1, 1.2%	0, 0%	1, 3.6%	
ASV (n, %)	3, 3.7%	3, 5.6%	0, 0%	
Settings				
IPAP (mean±SD)	19.2±4.4	18.6±4.3	20.3±4.4	0.103¥
EPAP (mean±SD)	7.47±2.4	7.41±2.4	7.57±2.4	0.778¥
RR (mean±SD)	16.1±1.9	11.2±5.0	12.7±3.6	0.115¥
Adherence				
1st month				
% days (mean±SD)	93.4±20.2	80.5±34.0	91.1±15.7	0.068¥
Hours/night (mean±SD)	7:46±2:40	7:01±2:35	7:01±2:20	0.997¥
12 months	89±26.6	81.6±33.3	88.8±26.8	0.454¥
% days (mean±SD)				
Hours/night (mean±SD)	7:59±2:37	7:26±2:57	7:34±1:49	0.867¥
$PaCO_2$ (mmHg, mean±SD)				
Baseline	51±10.5	49.5±9.4	53±8.1	0.101¥
1st month	44.6±6.9	43.7±6.2	46.2±7.9	0.186¥
12 months	42.3±7.0	41.6±6.6.	43.5±7.6	0.434¥
SpO_2 (%, mean±SD)				
Baseline	90.4±4.5	90.7±4.4	90.9±3.1	0.849#
1st month	94.1±3.2	93.9±3.3	95.1±1.5	0.093#
12 months	94.6±2.5	94.4±2.7	95.6±1.6	0.119#
NIV suspension (n, %)	14, 17.1%	10, 18.5%	4, 14.3%	0.762*
Refusal	6	5	1	
Intolerance to pressure	5	4	1	
Poor adherence	2	0	2	
LVEF <45%	1	1	0	
Admissions for RF (n, %)				
Before NIV				
0/year	39, 47.6%	28, 51.9%	11, 39.3%	0.352*
1-2/year	35, 42.7%	20, 37.0%	15, 53.6%	
>2/year	8, 9.7%	6, 1.1%	2, 7.1%	
1st year post NIV				
0/year	59, 71.9%	42, 77.8%	17, 60.7%	0.264*
0-1/year	21, 25.6%	11, 20.4%	10, 35.7%	
Mortality in 1st year (n, %)	16, 19.5%	9, 15.8 %	7, 25%	0.367*

*Chi-square,test or Fisher exact test; #independent samples *t*-test; AOT, ambulatory oxygen therapy; ASV, adaptative servoventilation; AVAPS, average volume, assured pressure support; EPAP, expiratory positive airway pressure; ILD, interstitial lung disease; IPAP, inspiratory positive airway pressure; LTOT, long term oxygen therapy; LVEF, left ventricle ejection fraction; OHS, obesity hypoventilation syndrome; OSAS, obstructive sleep apnoea syndrome; RR, respiratory rate; SD, standard deviation; ST, spontaneous/timed; S, spontaneous.

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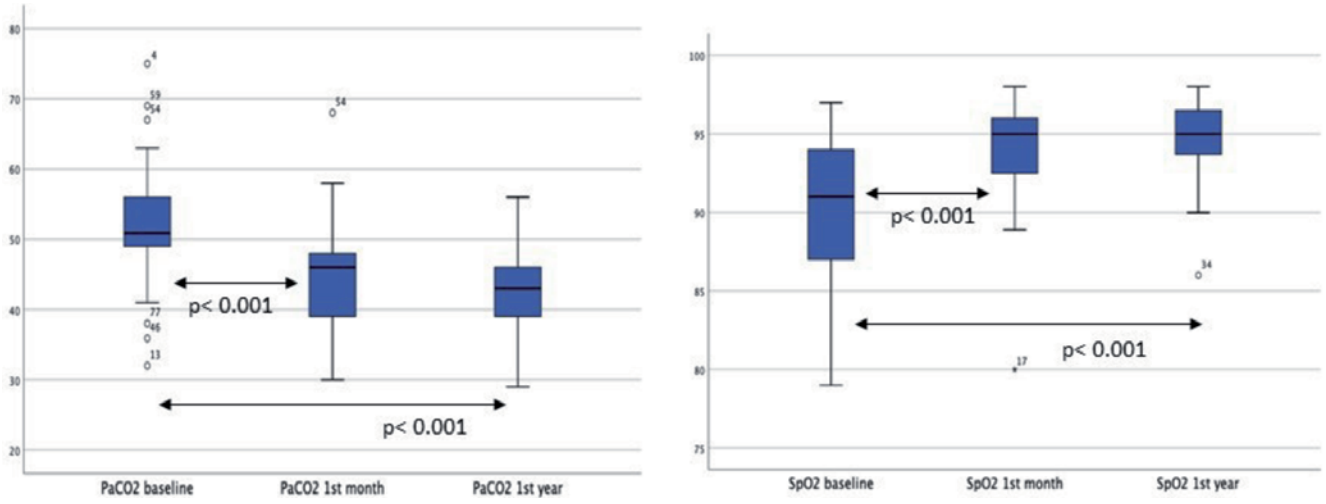

Figure 1. Variation in carbon dioxide arterial pressure ($PaCO_2$) and oxygen peripheral saturation (SpO_2).

in the baseline vs 44.6±6.9 mmHg in the first month, p<0.001). These values were maintained at 12 months with significant variation from baseline (SpO_2 94.6±2.5%, p<0.001; $PaCO_2$ 42.3±7 mmHg, p<0.001) (Figure 1).

A reduction in mean hospitalisations for respiratory failure compared with the previous year was also observed (1.02±1.6 *vs* 0.29±0.51, p<0.001). Sixteen patients died in the first year (19.5%). Mortality was associated with hospitalisation (38.1% mortality in patients with at least one hospitalisation in the follow-up year vs 10.2% mortality in patients without admissions, p<0.001).

When patients were divided into two age groups, under and over 85 years old, there were no significant differences between groups in none of the analysed variables (Table 1).

Our data outlines that home NIV is a well-tolerated and effective treatment in elderly patients, correcting hypercapnia and reducing hospitalisations.

NIV in the acute setting has well-established indications, and its feasibility in the elderly population has been shown [1,2]. In chronic patients, some indications, such COPD, are still lacking robust evidence, despite the physiological plausibility and disseminated prescription across Europe [3]. This paucity of evidence is even more noteworthy in the elderly. Few retrospective studies address the efficacy and tolerability of domiciliary NIV in elderly patients [4,5]; however, the mean age in these studies is under 80. In our study, the mean age is 82, and 34% of patients were above 85; nevertheless, the older group of patients still benefited from this therapy, having similar reductions in CO2 and hospitalisations. The described compliance was in line or slightly better than previously reported, both in general and elder population [4,5]. This study has several limitations, including its retrospective design. On the other hand, this is a heterogeneous cohort regarding the indication to initiate NIV treatment and further studies in elderly in NIV across different indications are needed. Nonetheless, since this cohort has a significant proportion of ancient patients benefiting, tolerating, and complying very well with home NIV, the authors considered it was relevant to share these data with the scientific community.

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