Enhancement of respiratory and cardiac frequency attributable to non-invasive ventilation in patients with chronic obstructive pulmonary disease and acute respiratory failure

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Abstract

Aim: The aim of this study was to compare respiratory frequency and cardiac frequency among patients with chronic obstructive pulmonary disease (COPD) and acute respiratory failure with and without administration of non-invasive ventilation (NIV).
Methods: This study consisted of 250 patients diagnosed with COPD and acute respiratory failure, hospitalized at the University Hospital of Lung Diseases "Shefqet Ndroqi" in Tirana during the period 2011-2014. Patients were split up into two groups: 125 patients underwent NIV, whereas 125 patients were administered the standard (conventional) treatment procedure. Mann-Whitney U-test was used to compare the mean values of respiratory and cardiac frequency between the two patients' groups upon hospital admission and, subsequently, upon hospital discharge.
Results: Upon hospital admission, there was evidence of a borderline statistically significant difference in the mean values of respiratory frequency in the two groups (P=0.091). Notably, there was a statistically significant difference in the mean values of cardiac frequency (P=0.039), with NIV patients exhibiting a higher mean value than the group with conventional therapy. Upon hospital discharge, mean values of both respiratory and cardiac frequencies were lower in patients with NIV than in those undergoing the conventional therapy (respiratory frequency: 23.2±1.9 vs. 28.2±2.8, respectively, P<0.001; cardiac frequency: 81.6±4.7 vs. 93.7±5.3, respectively, P<0.001).
Conclusion: This study shows that NIV enhances respiratory and cardiac frequency in patients with COPD and acute respiratory failure. Therefore, our findings indicate that it is necessary to administer NIV in patients with COPD and acute respiratory failure in order to improve their clinical outcomes.

Keywords: cardiac frequency, chronic obstructive pulmonary disease (COPD), lung diseases, non-invasive ventilation, respiratory frequency.

Introduction

Several studies, including randomized controlled trials but also meta-analyses, have already pointed to significant advantages of non-invasive ventilation (NIV) for the treatment of acute respiratory failure in chronic obstructive pulmonary disease (COPD) patients (1,2). The main documented advantages of NIV consist of a significant improvement of blood gas tensions and dyspnea (3-5). In addition, some studies have also documented a significant reduction of in-hospital mortality (3,6). Hence, based on the current body of evidence, it is recommended to identify in the clinical practice patients who need to undergo NIV in order to benefit as much as possible from this treatment approach (4).

In 1991, after the breakdown of the communist regime, Albania embarked in the difficult journey towards a market-oriented economy. The transition, however, was characterized by tremendous political and socioeconomic changes which have also been reflected in the health status of the population (7). Remarkably, in the past two decades, there has been an important shift in the burden of disease from communicable diseases to non-communicable diseases including also the COPD (7). Thus, the available evidence suggests that there has been a gradual increase in the COPD death rate in Albania, especially in males (7,8). The excess COPD risk in Albanian males has been related to the high prevalence of smoking (7,8). In any case, data on the magnitude and determinants of COPD in Albania, as well as treatment and control of this disease in the presence of acute respiratory failure is scarce.

In this context, the aim of this study was to compare selected clinical parameters including respiratory frequency and cardiac frequency in patients with COPD and acute respiratory failure with and without administration of NIV.

Methods

This was a case-series study which was carried out during the period 2011-2014 including 250 patients diagnosed with COPD and acute respiratory failure who were hospitalized at the University Hospital of Lung Diseases "Shefqet Ndroqi" in Tirana, the capital city of Albania.

Patients were split up into two groups: 125 patients were administered NIV, whereas 125 patients underwent the standard (conventional) treatment procedure.

Socio-demographic data and information about behavioral characteristics was gathered for all patients included in the study based on their respective medical charts and a structured interviewer-administered questionnaire. Demographic data consisted of age, sex, place of residence (urban areas vs. rural areas) and marital status (which was dichotomized in the analysis into: married vs. widowed/divorced/single). Socioeconomic characteristics included employment status (categorized into: employed, unemployed and retired), educational level, social status and income level (all trichotomized into: low, middle and high). In turn, behavioral factors included current smoking (no vs. yes), alcohol consumption (categorized into: never, occasionally and regularly) and physical activity (trichotomized into: low, moderate and high).

This study was approved by the Faculty of Medicine in Tirana. All patients who agreed to participate in this study gave their informed consent.

Mann-Whitney U-test was used to compare the mean values of respiratory and cardiac frequency between the two patients' groups (that is subjects with NIV vs. those without NIV) both upon hospital admission and, subsequently, upon hospital discharge. In all cases, a p-value of ≤ 0.05 was considered as statistically significant. Statistical Package for Social Sciences (SPSS,

version 17.0) was used for all the data analyses.

Results

There was no evidence of any statistically significant differences regarding demographic characteristics (age, sex, place of residence and marital status) and socioeconomic factors (educational attainment, employment status, income level and social status) between patients with NIV and those without NIV (data not shown in the table). The distribution of respiratory frequency and cardiac frequency in patients with NIV and those without NIV upon hospital admission is presented in Table 1. Upon hospital admission, there was evidence of a borderline statistically significant difference in the mean values of respiratory frequency between the two groups (P=0.091). Notably, there was a statistically significant difference in the mean values of cardiac frequency (P=0.039), with NIV patients exhibiting a higher mean value than the group with conventional therapy.

Table 1. Distribution of respiratory frequency and cardiac frequency in patients with and without NIV upon hospital admission

PARAMETER	Without non-invasive ventilation (NIV) [N=125]		With non-invasive ventilation (NIV) [N=125]		P
	Mean±SD	95%CI of the mean	Mean±SD	95%CI of the mean	
Respiratory frequency	32.4±2.9	31.9-32.9	34.1±2.4	33.7±34.5	0.091
Cardiac frequency	97.2±6.8	96.0-98.4	109.7±8.3	108.2-111.2	0.039

The distribution of respiratory frequency and cardiac frequency in patients with NIV and those without NIV upon hospital discharge is presented in Table 2.

Table 2. Distribution of respiratory frequency and cardiac frequency in patients with and without NIV upon hospital discharge

PARAMETER	Without non-invasive ventilation (NIV) [N=125]		With non-invasive ventilation (NIV) [N=125]		P
	Mean±SD	95%CI of the mean	Mean±SD	95%CI of the mean	
Respiratory frequency	28.2±2.8	27.7-28.7	23.2±1.9	22.9±23.5	<0.001
Cardiac frequency	93.7±5.3	92.8-94.6	81.6±4.7	80.8-82.4	<0.001

Upon hospital discharge, mean values of both respiratory and cardiac frequencies were lower in patients with NIV than in those undergoing the conventional therapy (respiratory frequency: 23.2±1.9 vs. 28.2±2.8, respectively, P<0.001; cardiac frequency: 81.6±4.7 vs. 93.7±5.3, respectively, P<0.001).

Discussion

Main findings of this study comprising a sample of Albanian patients with COPD and acute respiratory failure include a significant enhancement of two important clinical parameters such as the respiratory frequency and the cardiac frequency due to administration of NIV. From this point of view, upon hospital discharge, compared with patients treated with conventional therapy, individuals who underwent NIV had a significantly more favorable mean value of both respiratory

frequency and cardiac frequency.

Our findings are generally compatible with many studies conducted in different countries (1-6). In particular, our finding regarding sustained clinical stability due to NIV is fully in line with some previous studies which have reported a significant reduction in the number of hospital admissions after three months of therapy (2,9). Yet, as we have argued in a previous report based on this sample of patients, the remarkable strength of our estimates may be partly explained by the selection of patients with a high probability of recurrent respiratory failure (10). Therefore, our findings should be replicated and confirmed in future studies that should be carried out in Albania and elsewhere.

This study may have some limitations which may concern the representativeness of the sample (selection bias) and the data quality (information bias). Notably, the study sample consisted of patients hospitalized only at the University Hospital of Lung Diseases "Shefqet Ndroqi" in Tirana. Hence, this study sample may not necessarily represent all patients with COPD and acute respiratory failure in Albania. Given this fact, findings from this study should not be generalized to the overall Albanian patients with COPD and respiratory failure, but only to subjects who are admitted at the University Hospital in Tirana. Furthermore, the tools employed for data collection consisted of standardized and valid instruments. This fact points to lack of information bias in the data collection procedures. Yet, we cannot exclude completely the differential reporting between patients from different socio-demographic groupings, which may bear the possibility of information bias, at least to a certain degree. Overall, given these potential limitations, findings of this study should be interpreted with caution.

In conclusion, notwithstanding the aforementioned potential limitations, our study demonstrates that NIV improves two important clinical parameters in patients with COPD and acute respiratory failure, namely the respiratory frequency and the cardiac frequency. Findings from this study bear important clinical implications which should be taken into consideration in the routine medical practice in Albania and elsewhere. From this viewpoint, it is important to identify in the clinical practice patients who need to undergo NIV in order to benefit as much as possible from this useful treatment strategy. Thus, medical doctors and other health care professionals in Albania and other countries should be aware of the clinical importance and benefits of NIV in patients with COPD and acute respiratory failure.

Conflicts of interest: None declared.

References

1. Ram FS, Picot J, Lightowler J, Wedzicha JA. Non-invasive positive pressure ventilation for treatment of respiratory failure due to exacerbations of chronic obstructive pulmonary disease. Cochrane Database Syst Rev; 2004. CD004104.

2. Funk GC, Breyer MK, Burghuber OC, Kink E, Kirchheiner K, Kohansal R, et al. Long-term non-invasive ventilation in COPD after acute-on-chronic respiratory failure. Respir Med 2011;105:427-34. DOI: 10.1016/ j.rmed.2010.09.005.

3. Plant PK, Owen JL, Elliott 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.

4. Plant PK, Owen JL, Elliott MW. Non-invasive ventilation in acute exacerbations of chronic obstructive pulmonary disease: long term survival and predictors of in-hospital outcome. Thorax 2001;56:708-12.

5. Martin TJ, Hovis JD, Costantino JP, Bierman MI, Donahoe MP, Rogers RM, et al. A randomized prospective evaluation of noninvasive ventilation for acute respiratory failure. Am J Respir Crit Care Med 2000;161:807-13.

6. Celikel T, Sungur M, Ceyhan B, Karakurt S. Comparison of noninvasive positive pressure ventilation with standard medical therapy in hypercapnic acute respiratory failure. Chest1998;114:1636-42.

7. Albanian Institute of Public Health. National health report: Health status of the Albanian population. Tirana, Albania; 2014.

8. Institute for Health Metrics and Evaluation (IHME). Global Burden of Disease Database. Seattle, WA: IHME, University of Washington; 2014. http:/ / www.healthdata.org (Accessed: October 11, 2016).

9. Casanova C, Celli BR, Tost L, Soriano E, Abreu J, Velasco V, Santolaria F. Long-term controlled trial of nocturnal nasal positive pressure ventilation in patients with severe COPD. Chest 2000;118:1582-90.

10. Fype E, Nuredini O, Goga M, Cuko A, Kertoci R, Skenduli I, Ohri I. Improvement of biochemical parameters due to non-invasive ventilation in patients with chronic obstructive pulmonary disease and acute respiratory failure. Alban Med J 2016;3:35-8.