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ORIGINAL ARTICLE

OUTCOMES OF NONINVASIVE VENTILATION USE FOR COMMUNITY ACQUIRED PNEUMONIA PATIENTS IN INTENSIVE CARE UNIT: COMPARISON BETWEEN SUCCESS AND FAILURE

SAINT-CLAIR BERNARDES NETO[1], FÁBIO FERREIRA AMORIM[1], FERNANDO BESERRA DE LIMA[1], MARCELO DE OLIVEIRA MAIA[1], ROBERTA FERNANDES BOMFIM[1], JOSÉ AIRES ARAÚJO NETO[1]

[1]*Intensive Care Unit, Hospital Santa Luzia,Distrito Federal, Brasília, Brazil*

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Background: Noninvasive ventilation (NIV) is a recommended treatment for acute respiratory failure (ARF) in selected patients in the intensive care unit (ICU). But its use for hypoxemic patients with community acquired pneumonia (CAP) is controversial. **Objectives:** Analyze outcomes of NIV use for hypoxemic patients with CAP in ICU. **Methods:** Retrospective cohort in the ICU of Hospital Santa Luzia, Brasília-DF (Brazil) during 5 years (January 2010 - December 2014). All patients with diagnosis of CAP that received NIV as treatment for ARF with hypoxemia were included. Patients were divided in 2 groups: Success Group (SG) and Failure Group (FG), considered as invasive ventilation need. **Results:** 116 patients were enrolled in the study. Age was 68.9±17.7 years, APACHE II: 15.1±7.5. A total of 65 (56%) were included in the SG and the mortality rate was 43.1% (50 patients), while all the others were discharged from the ICU. There were no differences between the groups (SG and FG, respectively) in age (58.6±18.2 x 68.6±18.2; p=0.51), APACHE II (14.2±7.1 x 16.4±7.9; p=0.68), length of stay in ICU (15.5±11.3 x 21.3±24.6; p=0.11) or length of hospitalization (22.8±14.6 x 25.9±32.2; p=0.15). There was difference just in the total time of NIV use (4.9±4.4 x 6.7±11.4; p=0.01). When mortality was analyzed between the groups it was significantly different (21.2% x 70.6%; p<0.01). **Conclusions:** The success of NIV use in CAP ICU patients is associated to lower mortality rate but the failure is associated to higher time of NIV use and mortality, justifying a careful use with constant monitoring.

Corresponding Author

Saint-Clair Bernardes Neto (netosam@gmail.com)

INTRODUCTION

Noninvasive ventilation (NIV) is a form of ventilatory support defined by the delivery of positive pressure to the lungs using a mask or similar device, avoiding airway invasion by an endotracheal tube[1-5]. Its use has increased in the last two decades in intensive care units (ICU) and emergency departments for the treatment of selected patients with acute respiratory failure (ARF)[3,6-8].

The appropriate selection of patients for the NIV use is the key to a successful application[4] and there is currently robust evidence supporting its use for chronic obstructive pulmonary disease (COPD) patients with acute exacerbation[1-2,4,6-7,9-15] and for cardiogenic pulmonary edema (CPE)[3,7,11-15], decreasing the need for intubation and mortality.

NIV is frequently used as a first line treatment for ARF, independently of its cause, including patients with acute hypoxemic respiratory failure (AHRF)[2,7,16-18]. The beneficial effects for this group, in the absence of a cardiac origin or COPD, remain unclear[19] and is more likely to fail[17] or have no benefits[20]. In the other hand, some studies showed lower intubation rates and mortality[21-22].

The use of NIV for patients with community acquired Pneumonia is not supported by unanimous evidence[1-2] since some studies showed no benefits[4,8,23] while others demonstrated beneficial response such as reduced need for invasive mechanical ventilation and decreased mortality or no worsening[22,24].

Pneumonia itself is the most common cause of death for all infectious diseases[25] and patients with this diagnosis often require endotracheal intubation, which is associated with complications[16]. It is also associated with high hospitalization mortality rates[19].

The NIV treatment for ARF success rate ranges around 75% for hypercapnic patients, meanwhile the hypoxemic patients succeed around 50%[6,26]. These data suggest the need for a careful decision and evaluation of NIV use for hypoxemic patients with CAP. Because of this, the purpose of this study was to explore the outcomes of CAP patients that underwent NIV treatment for AHRF between the successful and failure individuals. Our hypothesis is that success and failure rates are similar, but the beneficial effects for successful patients lead to lower mortality and ICU length of stay.

MATERIALS AND METHODS

A retrospective cohort was carried out in the ICU of Hospital Santa Luzia, Brasília-DF, during 5 years (from January 2010 until December 2014). This ICU is an adult medical-surgical unit with 56 beds.

All adult patients at admission (≥ 18 years old) with clinical diagnosis of CAP, that were hospitalized in the ICU between January 1st, 2010 and December 31st 2014, and that received NIV as treatment for ARF with hypoxemia (PaO_2/ FiO2 ratio ≤ 300 mmHg)[27], were included.

Patients with NIV indication for other conditions; that already used NIV at home; and that were selected to go straight to invasive mechanical ventilation were excluded from the study.

The multiprofessional team decided the NIV treatment, after that it was applied and monitored by the physical therapy team. The application was carried as determined in the physical therapy protocol. The protocol was driven targeting expiratory tidal volume around 6 mL/kg and oxygen saturation (SpO_2) ≥ 92%.

The pressure-support ventilation was the modality chosen using an inspiratory pressure (pressure-support) and a positive end-expiratory pressure (PEEP), with 3 L/minute inspiratory trigger, to reach the target ventilation setting[2,28].

The physical therapy team made the adjustments as the NIV was applied for a 0.5 to 2 hours period. As the signs of respiratory distress improved the treatment with NIV could be extended for further evaluation according to the multiprofessional team or discontinued if possible, otherwise it was called failure[2,28]. So failure of NIV was considered when the patient ended requiring tracheal intubation and invasive mechanical ventilation. If failure was observed the patients were indicated to be immediately submitted to intubation and invasive mechanical ventilation.

Data were collected from the physical therapy monitoring formulary and from the electronic medical record. The variables collected were: age (years), sex, Acute Physiology and Chronic Health Evaluation II (APACHE II) score, ICU and hospital length of stay (days), total time of NIV use (hours), success/failure rate and mortality.

For statistical analyze patients were characterized with mean, standard deviation and frequency. The mean was

compared dividing the patients in two groups: Success Group (SG) and Failure Group (FG). The data distribution was tested in the sample by Kolmogorov-Smirnov test and *t* test was used for the means comparison for the normal distribution while the Mann-Whitney test was used for the not normally distributed means. For the comparison of frequency the Chi-Square test was used. All data were analyzed using the Statistical Package for the Social Sciences (SPSS) 22.0 for windows. In all the tests, the significance level adopted was of 5%.

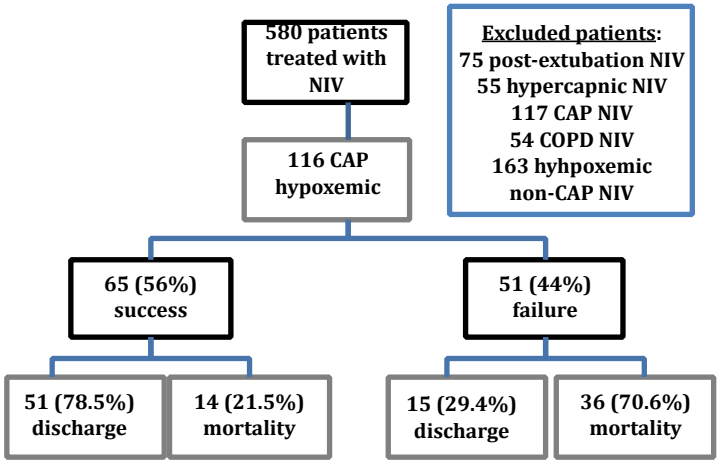

Figure 1. Sample selection, success or failure of NIV application and outcome (discharge from ICU or in-ICU mortality)

RESULTS

Based on the inclusion criteria, 116 patients were submitted to NIV treatment for severe community acquired Pneumonia with hypoxemia as the main indication treatment for NIV in the period studied. Fifty nine (50.9%) were male and the death risk (obtained by the APACHE II score) was 23.5%. The general descriptive variables are shown in Table 1.

All the patients received antibiotics and other drugs for the treatment of pneumonia, as prescribed by the physicians. NIV failure was found in 51 occasions (44%). From the total sample 66 (56.8%) were discharged from the ICU meanwhile the other 50 (43.1%) dyed in the ICU, as shown in Fig 1. with the outcomes separated by the groups.

The results of the comparison between SG and FG are presented in Table 1, where it is possible to observe that only the total time of NIV use had a significant difference, indicating that the FG used the NIV treatment for more time, before considered as failure.

When the patients discharged from the ICU and the in-ICU mortality patients were compared, only the total time of NIV use was different: SG with 5.4±4.8 x 11.2±19.4 hours ($p < 0.01$) and FG with 3.2±1.8 x 5.0±5.7 hours ($p = 0.04$).

Chi-square test was done to compare mortality and discharge with success and failure. The mortality was significantly higher for the FG and significantly lower for the SG ($p < 0.01$) as seen in Table 2.

Table 1. Sample general descriptive variables and comparison between SG and FG

Variable	Total Sample (n = 116)	SG (n = 65)	FG (n = 51)	*p*
Age (years)	68.9 ± 17.7	58.6 ± 18.2	68.6 ± 18.2	0.51
APACHE II	15.1 ± 7.5	14.2 ± 7.1	16.4 ± 7.9	0.68
Length of stay in ICU (days)	18.0 ± 18.4	15.5 ± 11.3	21.3 ± 24.6	0.11
Length of hospitalization (days)	24.1 ± 23.7	22.8 ± 14.6	25.9 ± 32.2	0.15
Total time of NIV use (hours)	5.7 ± 8.2	4.9 ± 4.4	6.7 ± 11.4	0.01*

Data are expressed by mean and standard deviation. SG: success group; FG: failure group; p: p value; APACHE II: acute physiology and chronic health evaluation; ICU: intensive care unit; NIV: noninvasive ventilation; * $p \leq 0.05$ (t test).

Table 2. Comparison between discharge and in-ICU mortality in SG and FG

	NIV Success (n = 65)	NIV Failure (n = 51)
Discharge from ICU (n = 66)	51	15
In-ICU mortality (n = 50)	14	36

Data are expressed by absolute values. NIV: noninvasive ventilation; ICU: intensive care unit; $p \leq 0.05$ (Chi-square test).

DISCUSSION

The main risk factor for NIV failure in the present study was the total time of NIV use, also associated with higher mortality. This finding is in accordance with Thille et al.[19] that showed that NIV failure with delayed intubation may worsen outcome and Cabrini et al.[9] that reported the survival benefit of NIV could be lost when it is applied late, as a rescue treatment. Romero-Dapueto et al.[1] also highlighted that delaying the endotracheal intubation, for CAP patients receiving NIV may increase mortality and lead to other intubation-related complications[1,29]. But when the NIV is used with no failure definition, and also with no postponed intubation, it can be applied during a longer duration and present no influence on outcomes[1,19].

The subjects more likely to fail the NIV usually have more severe respiratory acidosis, poorer tolerance to NIV, shock on admission, moderate/severe acute respiratory distress syndrome (ARDS), higher APACHE II, Sequential Organ Failure Assessment (SOFA) or Simplified Acute Physiology Score (SAPS) II score, lower level of consciousness, were older, were more hypoxemic and had a higher breathing frequency[8,19,21, 30-31]. And it is also known that the pneumonia itself or hypoxemia are known to be a risk factor for NIV failure[16,30,32-33]. Mosier et al.[29] found that almost half of the patients intubated after NIV failure had pneumonia clinical diagnosis[29]. In the sample presented in the study, patients had no poor tolerance for NIV, shock on admission or lower level of consciousness, otherwise they were directly indicated for invasive ventilation.

The positive effects of the application of NIV in the sample studied may be due to oxygenation improvement related to decreased intrapulmonary shunt, collapsed alveoli recruitment by the positive pressure and increased functional residual capacity[1].

Even though the majority of the sample was discharged from the ICU, there are several references that the NIV failure is associated with poor outcomes such as necessity of intubation[23,34] or increased mortality[18]. And some other studies showed that the NIV success leads to mortality reduction[9,13-14,24] or avoid intubation[5,13-14,19-21].

NIV failure was defined as the need for intubation and mechanical ventilation[7]. The failure rate found in this study is similar to the result of Thille et al.[19], with a failure rate of 54%, being 61% for ARDS patients and 35% for non-ARDS ones. Other studies reported different failure rates, varying from 5 to 40%[20-21]. One of the main characteristic for higher failure rate was the presence of contraindications, raising the rate up to 70%[7].

The high level of NIV failure for CAP patients makes the benefit of NIV for these subjects still controversial[5,21,34]. The protocol used in this study applied the NIV for an initial period of 30 minutes to 2 hours, and after that time with no improvement it was considered failure. If patients succeed they were encouraged to keep its use until the physical therapist decided it could be totally weaned. This initial time is based on current evidence that suggest patients should be evaluated in that time as the best predictor of eventual outcome[26,31-33].

The degree of hypoxemia or respiratory acidosis and SAPS II score were not evaluated and can be cited as an important limitation of the present study. The retrospective

design of the study is an important limiting factor, since it becomes impossible to perform a more detailed comparative analysis of the patients or their variables. The clinical decision for the time of use of the NIV treatment is very subjective and contributes to the negative failure results.

CONCLUSION

The success rate for the use of NIV in CAP ICU patients is quietly higher, but it was associated to a lower mortality rate. The failure is associated with a higher time of NIV use, justifying a careful use with constant monitoring to identify the necessity of early intubation when the NIV failure is determined.

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