

# Ventilação Não-Invasiva na Falência Respiratória Aguda

## *Non-Invasive Ventilation in Acute Respiratory Failure*

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### Resumo:

**Introdução:** A ventilação não invasiva (VNI) é uma opção válida, ainda que não consensual, no tratamento de doentes com falência respiratória aguda. O presente artigo tem o objetivo de identificar fatores preditores de resposta à VNI neste grupo de doentes.

**Métodos:** Estudo retrospectivo longitudinal que incluiu todos os doentes admitidos numa unidade de cuidados intensivos nos anos 2016 e 2017, nos quais a VNI foi utilizada no decurso de falência respiratória aguda de novo ( $\text{PaO}_2/\text{FiO}_2 < 200$ ). Foram incluídos doentes com pneumonia adquirida na comunidade (PAC) e síndrome da dificuldade respiratória aguda (SDRA) e comparados doentes com resposta à VNI com os não respondedores.

**Resultados:** Entre 2016 e 2017, 83 doentes com falência respiratória aguda de novo foram tratados com VNI. Destes, 50 (60%) foram tratados com sucesso. A causa mais comum de falência respiratória foi a PAC, que registou valores de resposta à VNI de 70%. Doentes respondedores à terapêutica de ventilação não invasiva apresentaram scores de gravidade (APACHE 2; SAPS 2; SOFA) inferiores à admissão (17,5; 37,5; 6 vs 22; 48; 9,  $p=0,014$ ,  $p<0,01$  e  $p<0,01$ , respetivamente). Os não respondedores apresentaram valores significativamente inferiores de pH arterial (7,35 vs 7,42,  $p<0,01$ ), rácio  $\text{PaO}_2/\text{FiO}_2$  (118 vs 145,  $p=0,03$ ), e valores significativamente superiores de lactato sérico (2,2 vs 1,46,  $p<0,01$ ) assim como maior necessidade de suporte vasopressor (51,5% vs 30%,  $p=0,04$ ). No que diz respeito a dados gasimétricos após início de VNI, o rácio  $\text{PaO}_2/\text{FiO}_2$  registou um aumento superior e estatisticamente significativo no grupo de doentes com resposta à VNI (+53,  $p<0,01$  vs +14,  $p=0,09$ ).

**Conclusão:** A VNI foi eficaz como estratégia ventilatória em 60% dos doentes com falência respiratória aguda. Os doentes que aparentam ter maior probabilidade de resposta à introdução da VNI são: doentes com PAC, com ou sem SDRA moderado (em detrimento do SDRA severo), doentes sem acidemia respiratória e doentes sem hiperlactacidemia e/ou necessidade de suporte vasopressor. A melhoria do *ratio*  $\text{PaO}_2/\text{FiO}_2$  após

as primeiras duas horas de VNI parece ser um bom preditor de sucesso.

**Palavras-chave:** Síndrome da Dificuldade Respiratória; Ventilação Não Invasiva.

### Abstract:

**Introduction:** Non-invasive mechanical ventilation (NIV) is a valid, albeit non-consensual option for the treatment of patients with Acute Respiratory Failure (ARF). The following article has the main goal of identifying predictors of therapeutic response to NIV.

**Methods:** Retrospective longitudinal study which included patients in an Intensive Care Unit in 2016 and 2017, in whom NIV was started once they developed de novo ARF ( $\text{PaO}_2/\text{FiO}_2 < 200$ ). We included patients with community acquired pneumonia (CAP) and acute respiratory distress syndrome (ARDS) and compared NIV-responders to non-responders.

**Results:** Between 2016 and 2017, 83 patients with de novo ARF were treated with NIV. Of those, 50 (60%) were treated successfully. The most common cause of ARF was CAP, which was successfully managed with NIV in 70% of cases. NIV-responders presented lower severity scores (APACHE 2; SAPS 2; SOFA) at admission (17.5; 37.5; 6 vs 22; 48; 9,  $p=0.014$ ,  $p<0.01$  and  $p<0.01$ , respectively). Non-responders presented significantly lower arterial pH values at admission (7.35 vs 7.42,  $p<0.01$ ),  $\text{PaO}_2/\text{FiO}_2$  ratio (118 vs 145,  $p=0.03$ ), higher seric lactate (2.2 vs 1.46,  $p<0.01$ ) as well as need for vasopressor support (51.5% vs 30%,  $p=0.04$ ). The change in the  $\text{PaO}_2/\text{FiO}_2$  ratio within 2 hours of treatment was wider in the group of NIV-responders, unlike non-responders (+53,  $p<0.01$  vs +14,  $p=0.09$ ).

**Conclusion:** NIV was an effective respiratory support strategy in 60% of patients with de novo ARF. Patients who seem to have a higher probability of NIV success are: patients with CAP; with or without moderate ARDS, rather than severe; with no respiratory acidemia; patients with no lactacidemia or patients with no need for vasopressor therapy. The ability of NIV to significantly alter the  $\text{PaO}_2/\text{FiO}_2$  ratio after 2 hours of technique seems to be a good success predictor.

**Keywords:** Noninvasive Ventilation; Respiratory Distress Syndrome.

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## Introduction

Non-invasive ventilation (NIV) is a safe ventilatory strategy to improve hypoxemia in patients with multiple causes of acute respiratory failure (ARF).<sup>1</sup> The major advantage associated with NIV lies in its ability to override the need for intubation, thereby reducing complications associated with airway manipulation.<sup>2</sup> Other non-negligible additional advantages are: the absence of need for sedation (and eventual curarization); the ability to maintain neurological monitoring and the lower risk of barotrauma.

The use of NIV is particularly well studied and recommended in ARF secondary to exacerbation of chronic obstructive pulmonary disease (COPD) and cardiogenic pulmonary oedema/decompensated heart failure. Although with less evidence, its benefit is still recognized in addressing postoperative respiratory failure, in managing ARF in immunocompromised patients and as prevention of post-extubation hypercapnia in high-risk patients.<sup>1</sup>

Current evidence suggests caution in the use of NIV as the preferred initial ventilatory method in *de novo* hypoxemic ARF due to the high failure rates. This is related to the delay in identifying signs of NIV failure and the consequent delay in invasive mechanical ventilation (IMV), which is associated with increased morbidity and mortality.<sup>3</sup> Accordingly, the latest guidelines of recognized societies- European Respiratory Society (ERS) and American Thoracic Society (ATS) - do

not provide recommendation on the use of NIV in *de novo* ARF (in favour or against).<sup>1</sup>

More recent data points to the possible advantage of using NIV in a controlled manner in patients with *de novo* ARF, highlighting higher success rates.<sup>4</sup> However, most studies have a strict population sample, which compromises the external validation of the evidence.<sup>3,5,6</sup> Therefore the role of NIV in *de novo* ARF remains undefined and, although often used in this context, hypoxemic ARF remains an informal indication for NIV.

The present study aims to evaluate the use of NIV in the group of *de novo* ARF patients treated at an Intensive Care Unit (ICU), to identify success predictors of its use, and to define groups in which NIV can prevent IMV.

## Methods

A longitudinal retrospective study was conducted involving patients admitted to the Centro Hospitalar de Trás-os-Montes e Alto Intensive Care Unit of Douro from 2016 to 2017 in which non-invasive ventilation was initiated during newly diagnosed acute respiratory failure ( $PaO_2 / FiO_2 < 200$ ). Patients with community acquired pneumonia (CAP) and acute respiratory distress syndrome (ARDS), according to Berlin criteria, were included. Due to the retrospective character of this study, no ethics approval was required for the presentation of this paper.

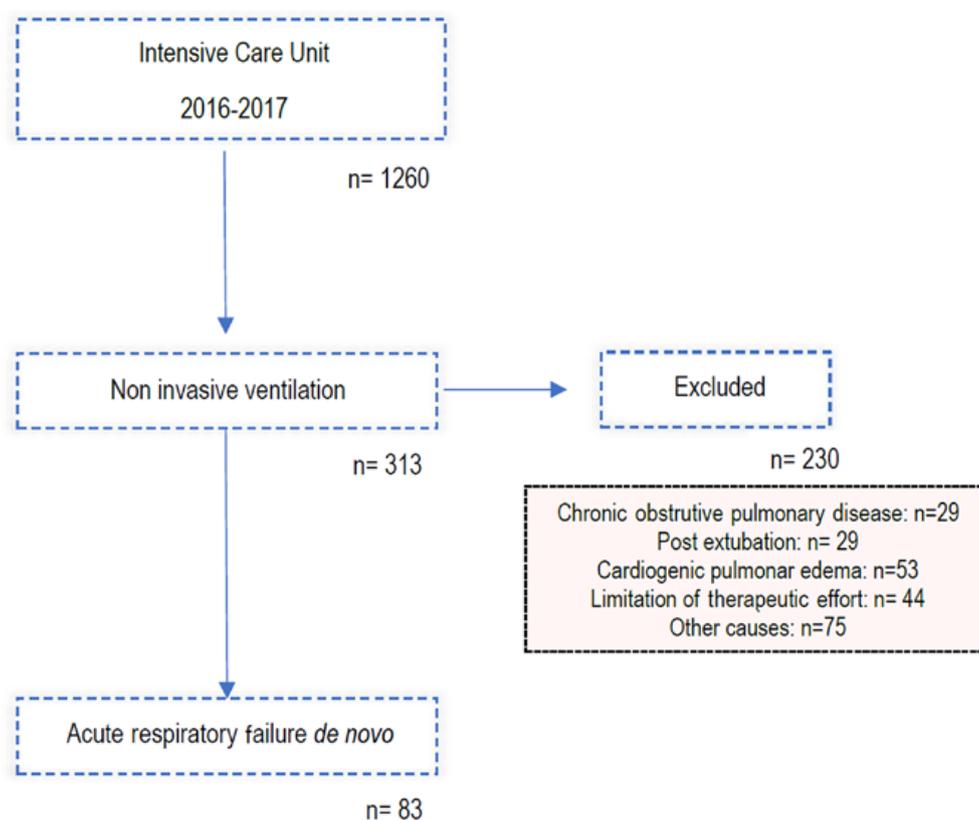


Figure 1: Patient inclusion diagram.

Data were collected through consultation of clinical files (medical and nursing files). In addition, we also obtained data from the records of a recently implemented protocol in the unit on the use of NIV. This protocol records hourly clinical data (including respiratory rate), as well as evolutionary gas data from all patients on NIV.

As can be seen in image one, we excluded patients with:

1. Respiratory failure due to COPD exacerbation
2. Respiratory failure due to cardiogenic pulmonary oedema
3. Respiratory failure in immunocompromised patients
4. Post-extubation respiratory failure
5. Respiratory failure as a consequence of trauma
6. Therapeutic effort limitation (TEL).

Response to NIV introduction was considered when patients fulfilled all of the following clinical and gasometric criteria:

1. pH normalization (in patients with abnormal arterial pH on admission) and
2. Decreased respiratory effort with respiratory rates (RR) less than 25 cycles per minute and
3. Improvement of PaO<sub>2</sub> / FiO<sub>2</sub> ratio to greater than 200

None of the patients that fulfilled all of the above criteria needed to be invasively ventilated nor died. These patients were included in the “Responders” group. Patients who failed to meet all the above clinical and gasometric criteria of response to NIV application were intubated and invasively ventilated and included in the “Non-responders” group.

Due to the retrospective nature of our study, the group of work decided not to define a limited time to response, as we also included patients with late response to NIV (after 24 hours on NIV).

We compared the “Responders” group with patients who failed to respond, according to demographic data, blood gas and severity scores at admission. The used severity scores were the “Acute physiology and chronic health evaluation (APACHE) II”,<sup>7</sup> the “Simplified Acute Physiology Score (SAPS) II”<sup>8</sup> and the “Sequential Organ Failure Assessment (SOFA) Score”.<sup>9</sup>

We focus on the comparison of groups with regard to clinical and gasimetric findings in the first two hours after initiation of NIV, with the ultimate goal of trying to identify factors for early prediction of NIV success.

Statistical treatment of data was performed using the IBM SPSS v23 program. Quantitative variables with normal distribution were described as means and standard deviations. For quantitative variables with non-normal distribution, we used the median and interquartile distance. Qualitative variables were reported as absolute number and percentages. Student’s t-test was used to compare means amongst groups of independent samples. For variables with

non-normal distribution, the corresponding nonparametric version of the above-mentioned test was used: Mann-Whitney U. The normality and heteroscedasticity of the variables were studied using the histogram (with its privilege), the Kolmogorov-Smirnov test and the Levene test. Hypothesis tests were considered significant whenever the respective test value (p value) did not exceed the significance level of 5%.

## Results

From 2016 to 2017, 83 patients with de novo ARF were treated with NIV. Regarding demographic data (Table 1), 48 patients (57.8%) were male and 35 (42.2%) female, with a median age of 67 ± 22. The sample was composed mainly by medical admissions (96.4%) although 3 patients had ARF in the postoperative context. In terms of severity scores on admission, the sample presented an average APACHE score of 19.8 ± 7.2, median SAPS II score of 42 ± 17, and a median SOFA score of 7 ± 5. The most common comorbidity was heart failure, identified in 40.9% of the patients, followed by chronic liver disease (22.9%), diabetes *mellitus* (20.5%), COPD (19.3%) and arrhythmogenic heart disease (18.1%). The preferential ventilation mode was continuous positive airway pressure (CPAP), used in 61% of the cases, in agreement with the main indication for NIV in these patients - isolated hypoxemia with PaO<sub>2</sub>/ FiO<sub>2</sub> ratio <200, without hypercapnia or respiratory acidosis. In 75 of the 83 patients (90.4%) NIV was introduced in the ICU, 42.7% of them (35 patients) started the ventilatory support within the first hour. Overall, NIV succeeded in 50 patients (60%). The most common aetiology of ARF was the CAP (bacterial or viral) where the success rate approached 70%. Of the 20 secondary ARDS patients, 14 represented therapeutic failure (70%) requiring rescue IMV. Of note we had a high prevalence of secondary ARDS caused by acute necrotizing pancreatitis, 7 out of 20 patients (35%) all of them failed to respond to NIV.

In 12 out of 50 successfully treated patients (24%), the timing to response was only one hour. However, a significant proportion of patients (21/42%), whose NIV introduction was considered successful, showed late total response (i.e. after 24 hours).

Patients who succeeded presented significantly lower pre-NIV severity scores (APACHE II of 17.5 *versus* 22; SAPS II of 37.5 *versus* 48; SOFA score of 6 *versus* 9; *p* < 0.001). Therapeutic success was independent of gender (*p* = 0.969), age (median age of 64 in the unsuccessful treated group *versus* 67 in the group with response to NIV introduction *p* = 0.773), type of admission (medical *versus* surgical, *p* = 0.560) and most of the comorbidities, as shown in Table 2. One should emphasize that these findings, particularly those related to age and gender, made the groups (responders *versus* non-responders) comparable. Nevertheless, it must be noted that patients with favourable response to NIV introduction, had a

**Table 1:** Sample general characterization.

<b>Age (x±IQR)</b>	67,0±22
<b>Gender (n/%)</b>	
Male	48/57.8
Female	35/42.2
<b>Causes of ARF</b>	
<b>Primary ARF/ARDS</b>	<b>63</b>
Bacterial CAP	56
Viral CAP	6
H1N1	5
Influenzae B	1
Other causes	1
Aspergillus	1
<b>Secondary ARF/ARDS</b>	<b>20</b>
Cholangitis	2
Acute necrotizing pancreatitis	7
Pyelonephritis	6
Mesenteric ischemia	1
Secondary peritonitis	1
Soft tissue infection	1
Leishmaniasis	1
Malaria	1
<b>UCIP Hospitalization days (μ±σ)</b>	8±13
<b>Global Hospitalization days (μ±σ)</b>	14±26
<b>Severity scores</b>	
APACHE II (μ±σ)	19,8±7.2
SAPS II (x±IQR)	42±17
SOFA at admission (x±IQR)	7±5
SOFA at the beginning of NIV (x±IQR)	6±5
<b>Comorbidities (n/%)</b>	
Heart Failure	34/40.9%
Ischemic heart disease	9 / 10.8%
Arrhythmogenic heart disease	15/18.1%
Previous stroke	3/3.6%
COPD	16/19.3%
Asthma	3/3.6%
Pulmonary interstitial disease	1/1.2%
Restrictive lung disease	2/2.4%
Neuromuscular	1/1.2%
OHS	3/3.6%
OSA	6/7.2%
Active neoplasia	2/2.4%
Terminal CKD	4/4.8%
Diabetes	17/20.5%
CLD	19/22.9%
Immunodepression	
Drug-related	15/18.1%
Neoplasia	2/2.4%
HIV	2/2.4%
<b>Therapeutic success (n/%)</b>	50/60.2%
<b>UCIP overall mortality (n/%)</b>	12/14.5%
<b>Hospital mortality (n/%)</b>	13/15.7%
<b>Progression to IMV (n/%)</b>	21/25.3%

COPD: chronic obstructive pulmonary disease; OHS: obesity hypoventilation syndrome; OSA: obstructive sleep apnea syndrome; CKD: chronic kidney disease; CLD: chronic liver disease; HIV: human immunodeficiency virus. X= median; μ= mean; IQR= interquartil range; σ= standard deviation; n= absolute number;

significantly higher rate of heart failure as comorbidity (50% in opposition to 27.3% in the failing group,  $p = 0.039$ ). Table 3 (A and B) shows the blood gas variables of the groups in comparison at time 0 (moment of introduction of NIV) and at time 2 (2 hours after the onset of the technique). Table 3C shows the differences in the blood gas variables between the time of admission and two hours after beginning ventilatory technique, in an attempt to find predictors of success for NIV use through gasometric changes.

Patients who failed to respond to NIV presented significantly lower pre-treatment values in arterial pH (7.35 vs 7.42;  $p < 0.001$ ) as well as PaO<sub>2</sub>/FIO<sub>2</sub> ratio (118 vs 146,  $p = 0.03$ ). Concomitantly, they presented significantly higher serum lactate values (2.2 mmol/L vs 1.46 mmol/L,  $p < 0.001$ ) as well as higher need for vasopressor support (51.5% vs 30%,  $p = 0.04$ ). In contrast, PaCO<sub>2</sub> was not significantly different between groups (41.3 mmHg in the success group versus 43.2 mmHg in the NIV failed group,  $p = 0.60$ ). Two hours after the beginning of the technique, those differences remained.

Regarding the variation of clinical findings and blood gas variables after NIV introduction (difference between time variable 2 and time variable 0), the PaO<sub>2</sub>/FIO<sub>2</sub> ratio showed a significantly higher increase in the group that favourably responded to NIV, compared to the other (+53,  $p < 0.01$  vs +14,  $p = 0.09$ ). On the contrary, the variation of PaO<sub>2</sub> (+52,  $p < 0.001$ , in the success group vs +34,  $p < 0.001$  in the failed group) and the respiratory rate (RR) (-4.7,  $p < 0.001$  vs -5.0,  $p = 0.01$ ) had similar behaviour among the groups, increasing and decreasing, respectively. The arterial pH value (success +0.003,  $p = 0.6$ ; non-response group -0.01,  $p = 0.24$ ), the levels of serum bicarbonate (success +0.4,  $p = 0.3$ ; failure +0.2,  $p = 0.7$ ) and serum lactate levels (success +0.05,  $p = 0.6$ ; failure +0.2,  $p = 0.27$ ) did not change significantly between the moments evaluated in none of the groups above. The remaining blood gas and respective variables variation in first two hours are identified in the Table 3C.

## Discussion

In our sample, NIV avoided IMV in 60% of patients with *de novo* ARF criteria. This finding is in accordance to a recent observational study which showed a 62% to 68% success rate in the treatment of pneumonia with non-invasive positive pressure, depending on the ventilator mode.<sup>4</sup> However, 60.2% of this study's sample had a do not resuscitate (DNR) decision made prior to the start of NIV, thus limiting its power and applicability to the general population with indication for invasive life and organ support. In contrast, patients with a decision to withhold treatment were not included in our study (belonged to the exclusion criteria).

One of the biggest problems in regard to establishing recommendations for NIV in *de novo* ARF is due to the fact that most studies with positive results use a sample

**Table 2:** Sample general characterization – Comparison responders with non-responders.

	Non-responders (n=33)	Responders (n=50)	Significance level
<b>Demographic data</b>			
Male gender (n/%)	19/57.6	29/58.0	$p=0.969$
Age (x±IQR)	64 [21-83]	67 [30-86]	$p=0.773$
<b>Admission type</b>			
Medical (n/%)	31/93.9	49/98.0	$p=0.560$
<b>Causes of ARF</b>			
Primary ARF/ARDS	19/57.6	44/88	$p<0.001$
Secondary ARF/ARDS	14/42	6/12	
<b>Length of stay</b>			
UCIP Days (x±IQR)	10 [1-49]	7 [2-28]	$p=0.245$
Hospital Days (x±IQR)	17 [2-88]	13 [4-66]	$p=0.860$
<b>Severity scores</b>			
APACHE II ( $\mu\pm\sigma$ )	22 [11-39]	17,5 [6-36]	$p=0.014$
SAPS II (x±IQR)	48 [25-94]	37.5 [9-65]	$p<0.001$
SOFA at admission (x±IQR)	9 [3-23]	6 [1-17]	$p<0.001$
SOFA at the beginning of NIV (x±IQR)	8 [3-23]	5 [2-14]	$p<0.001$
<b>Comorbidities (n/%)</b>			
Heart Failure	9/27.3	25/50.0	$p=0.039$
Ischemic heart disease	3/9.1	6/12.0	$p=0.486$
Arrhythmogenic heart disease	3/9.1	12/24.0	$p=0.143$
Previous stroke	0/0	3/6.0	$p=0.277$
COPD	7/21.2	9/18.0	$p=0.717$
Asthma	1/3.0	2/4.0	$p\approx 1.000$
Pulmonary interstitial disease	1/3.0	0/0	$p=0.398$
Restrictive lung disease	0/0	2/4.0	$p=0.515$
Neuromuscular	0/0	1/ 2.0	$p\approx 1.000$
OHS	0/0	3/6.0	$p=0,277$
OSA	2/6.1	4/8.0	$p\approx 1.000$
Active neoplasia	0/0	2/4.0	$p=0.515$
Terminal CKD	0/0	4/8.0	$p=0.148$
Diabetes	6/18.2	11/22.0	$p=0.673$
CLD	6/18.2	13/26.0	$p=0.407$
Immunodepression			$p=0.862$
Drug-related	6/18.2	9/18.0	
Neoplasia	0/0	2/4.0	
HIV	1/3.0	1/ 2.0	

COPD: chronic obstructive pulmonary disease; OHS: obesity hypoventilation syndrome; OSA: obstructive sleep apnea syndrome; CKD: chronic kidney disease; CLD: chronic liver disease; HIV: human immunodeficiency virus.

X= median;  $\mu$ = mean; IQR= interquartil range;  $\sigma$  = standard deviation; n= absolute number;

of highly-selected patients.<sup>1,3,5,6,10</sup> Our study attempts to bypass that limitation by presenting a wide sample of patients with varying degrees of acute severity, pre-existing comorbidities and autonomy.

One of our key-messages is that prognosis seems to be more favourable in patients with CAP and primary ARDS, with success rates up to 70%. On the other hand, secondary ARDS was only successfully treated with NIV in 30% of the patients. This difference should be confirmed in studies with a larger dimension.

In our present study, we verified an association between the probability of success with NIV and lower severity scores. On the other hand, therapeutic success was independent from age, gender, admission type and most comorbidities, a similar finding to that reported by a 2014 Spanish study on

effectivity and predictors of failure of NIV.<sup>11</sup> The association between the presence of previous HF with no pulmonary oedema of cardiogenic origin and the higher rate of success with NIV is still not completely understood (in our sample, patients who responded favourably to NIV had a significantly higher incidence of HF even if it was not the reason for establishing NIV). This association might be due to “ARF-induced Acute HF”. It is known that patients with chronic cardiomyopathy and compromised systolic function can develop myocardial ischemia or low-output HF if respiratory work increases. The added work induced by ARF might increase the heart’s energy requirements in up to 10 times. Introducing ventilatory support, even if non-invasive, could improve cardiac output secondary to decreasing respiratory work, despite the lack of cardiogenic pulmonary oedema.<sup>12</sup>

**Table 3A:** Comparison of clinical and gasometric variables between the groups.

Variables on time 0 (at the beginning of ventilatory technique)

Time 0	Responders	Non-responders	p
Arterial pH	7.42	7.35	<0.001
pCO2 (mmHg)	41.3	43.2	0.6
pO2 (mmHg)	74.7	71	0.5
FiO2	0.57	0.63	0.3
PaO2 / FiO2	145.8	118	0.03
HCO3 (mmol/L)	26.8	23.3	0.035
Lactate level (mmol/L)	1.46	2.2	<0.001
RR(cpm)	30	28	0.4
Vasopressor (n/%)	15/30.0	17 /51.5	0.04

P<sub>co2</sub>: partial pressure of carbon dioxide; P<sub>O2</sub>: partial pressure of oxygen; FiO2: fraction of inspired oxygen; HCO3-: bicarbonate level; RR: respiratory rate; CPM: cycles per minute

**Table 3B:** Comparison of clinical and gasometric variables between the groups.

Variables on time 2 (two hours after introduction of NIV).

Time 2	Responders	Non-responders	p
Arterial pH	7.42	7.35	<0.001
pCO2 (mmHg)	41.25	45.3	0.3
pO2 (mmHg)	127	106	0.1
FiO2	0.66	0.82	0.01
PaO2 / FiO2	199	134	<0.001
HCO3 (mmol/L)	27	23	0.047
Lactate level (mmol/L)	1.35	2.4	<0.001
RR(cpm)	24	24	0.6
Vasopressor (n/%)	12/25.0	19/59.4	<0.001

P<sub>co2</sub>: partial pressure of carbon dioxide; P<sub>O2</sub>: partial pressure of oxygen; FiO2: fraction of inspired oxygen; HCO3-: bicarbonate level; RR: respiratory rate; CPM: cycles per minute

**Table 3C:** Comparison of clinical and gasometric variables between the groups.

Variation of gasometric and clinical data two hours after begging of NIV.

Gasometric variation (Time2- Time0)	Responders	p	Non-responders	p
Arterial pH	+0.003	0.6	-0.01	0.24
pCO2 (mmHg)	+0.2	0.8	+2.4	0.064
pO2 (mmHg)	+52	<0.001	+34	<0.001
FiO2	+0.08	0.02	+0.2	<0.001
PaO2 / FiO2	+ 53	<0.001	+14	0.09
HCO3 (mmol/L)	+0.4	0.3	+0.2	0.7
Lactate level (mmol/L)	+0.05	0.6	+0.2	0.27
RR (Respiratory rate)	- 4.7	<0.001	-5	0.01

P<sub>co2</sub>: partial pressure of carbon dioxide; P<sub>O2</sub>: partial pressure of oxygen; FiO2: fraction of inspired oxygen; HCO3-: bicarbonate level; RR: respiratory rate; CPM: cycles per minute

Regarding the ABGs and clinical findings 2 hours after establishing NIV, the PaO2/FiO2 ratio only seems to change significantly in the subgroup of patients who respond favourably to NIV. Thus, and in accordance to current evidence,<sup>11,13</sup> the variation in this ratio in the first 2 hours might be a good tool to decide between NIV or the need to establish IMV.

The ERS/ATS guidelines warns us that NIV is not effective in reducing respiratory work in patients with *de novo* ARF,<sup>1</sup> contrary to what is verified in patients with hypercapnic respiratory failure, where the ability of NIV to decrease respiratory work has been clearly demonstrated. Our study reinforces this idea once more, given that respiratory frequency did not decrease in a statistically significant fashion in patients who

achieved therapeutic success with NIV. As such, hypoxia should be our main focus in this group of patients, rather than seric pH.

This study is methodologically limited. Firstly, by its retrospective nature and secondly, it would have been important to evaluate the occurrence of events such as barotrauma, given that an important proportion of patients with ARDS need high expiratory pressures to improve oxygenation. External validity might also be hampered by our high proportion of patients with diagnosed HF; its impact on the therapeutic success of NIV is not yet clear when cardiogenic pulmonary oedema is absent.

In conclusion, this group of authors believes there is a role for NIV in selected patients with *de novo* ARF. Patients

who seem to have a higher probability of NIV success are: patients with CAP; with or without moderate ARDS, rather than severe; with no respiratory acidemia; patients with no lactacidemia or patients with no need for vasopressor therapy. Patients with HF also seemed to benefit.

The patients with *de novo* ARF that start NIV should be carefully monitored, since their response within the first hours can be used as a decision-making tool. Our group suggests that the delta in the PaO<sub>2</sub>/FiO<sub>2</sub> ratio might predict response to NIV. Nonetheless, the threshold for changing ventilatory strategies is still undefined, which underscores the need for an experienced professional to tailor the therapeutic strategy to the individual patient. ■

### Responsabilidades Éticas

Conflitos de Interesse: Os autores declaram a inexistência de conflitos de interesse na realização do presente trabalho.

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