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The Place of Non-Invasive Ventilation (NIV) in the Management of Acute Respiratory Failure in the Emergencies of Oran University Hospital Center

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Abstract: ***Introduction: Non-invasive ventilation (NIV) is one of the treatments for acute respiratory failure (ARF). The use of this technique in Algeria remains little known, as shown by the paucity of publications on the subject. The aim of this study is to estimate the frequency of recourse to NIV and to determine the failure factors associated with NIV in adult patients hospitalized for acute respiratory failure in the emergency department of the University Hospital Centre of Oran. Materials and Methods: This is a retrospective descriptive study spread over two years, from January 2018 to November 2019, and including all patients admitted for acute respiratory failure, which is defined as the inability of a patient to maintain normal haematosis. The haematosis disorder is characterized by hypoxemia, which is defined by clinical and gasometric criteria: polypnea-type dyspnea with a respiratory frequency of more than 25 C/min associated with signs of struggle and an SPO2 of less than 95% associated with an arterial blood oxygen partial pressure of less than 80mmHg with or without an increase in theCO2 partial pressure [9], [10]. To analyze the risk factors, a univariate analysis was performed using SPSS software, with a significance level of 5%. Results: Ninety-seven patients were hospitalized for ARI during this period. NIV was used in 37 patients (38.1%). 64.9% of patients who received NIV had acute lung oedema. The failure rate for this technique was 32.4%. Univariate analysis showed that Pulsed Oxygen Saturation was the only factor in failure in this series. Conclusion: NIV should be used more frequently in the management of ARF in emergency departments, which would reduce the need for intubation and mechanical ventilation (invasive techniques), especially in indications where the level of evidence in the literature is recommended.***

Keywords: Acute respiratory failure-non-invasive ventilation-mechanical ventilation-acute lung oedema-hypoxia-COPD decompensation

1. Introduction

Acute respiratory failure (ARF) is a frequent cause of emergency room visits and one of the main reasons for admission to intensive care.

It is a life-threatening condition, requiring immediate symptomatic treatment and an approach based on etiology. Among the causes of ARF, acute pulmonary oedema (APO), decompensation of chronic obstructive pulmonary disease (COPD), chest trauma and pneumopathy are the most common [1].

This is a life-threatening condition, with reported mortality in the order of 20-40% for ARF secondary to cardiogenic PAO. [4] [5]

The prevalence of ARI in Algeria remains unknown; the TAHINA study showed that respiratory diseases were the leading cause of hospital consultations [2].

The prevalence of COPD was found in 31.5% of smokers [3]. In addition, the number of patients admitted to hospital with chest trauma continues to rise, resulting in an increase in the number of patients admitted with ARF secondary to chest trauma. The management strategy includes management of the respiratory failure and treatment of the cause. [6]

Several methods are used to manage this type of distress, including non-invasive ventilation (NIV), which is a ventilatory assistance technique applied to patients with ARF, without recourse to tracheal intubation [4].

This technique has clearly demonstrated its effectiveness in treating the various etiologies of ARF. It reduces the need for intubation and mechanical ventilation, and therefore the risk of nosocomial infections [7].

However, this technique is contraindicated in patients who are comatose, have convulsive seizures, are haemodynamically unstable, have vomiting, recent gastro-oesophageal surgery or digestive haemorrhage, in cases of facial trauma or airway obstruction, and in cases of undrained pneumothorax. [8]

Although the efficacy of NIV is indisputable in the treatment of ARF of various causes, Sameer and colleagues report that a number of factors were responsible for the failure of this technique, such as the state of shock, the degree of hypoxia and acidosis [5].

Despite its many advantages, its use remains insufficient, as shown by the lack of scientific publications.

The aim of this study is to estimate the frequency of NIV use and to determine the associated NIV failure factors in adult patients hospitalized for ARF in the emergency department of CHU Oran from January 2018 to November 2019.

2. Materials and methods

- This is an exhaustive descriptive observational study, based on patient records. We included all subjects aged over 16

years hospitalized for AKI and who did not present with cardio respiratory arrest at the reception and resuscitation units of the emergency department of Oran University Hospital between January 2018 and November 2019.

Acute respiratory failure is defined as the inability of a patient to maintain normal haematosis [9]. The haematosis disorder is characterized by hypoxemia, which is defined by clinical and gasometric criteria: polypnea-type dyspnea with a respiratory rate of more than 25 C/min associated with signs of struggle and an SPO2 of less than 95% associated with an arterial blood oxygen partial pressure of less than 80mmHg with or without an increase in CO2partial pressure. [10].

NIV is a technique of mechanical respiratory assistance via a face mask (usually naso-buccal) using two ventilation modes: continuous positive airway pressure (CPAP) or spontaneous ventilation with inspiratory assistance and positive end-expiratory pressure (AI-PEP).

The following data were collected for each patient: age recoded as a dichotomous variable, sex, etiology of ARF, comorbidities, respiratory and cardiovascular parameters on admission (respiratory rate, blood pressure, heart rate and SPO2), and patient outcome. NIV failure was defined as intubation or death. The data were entered and analyzed using SPSS version 19 software.

Qualitative variables were expressed as percentages and quantitative variables as means plus or minus one standard deviation.

To identify risk factors associated with NIV failure, a univariate analysis was performed.

The Chi-square test was used, with significance set at 5%.

3. Results

Ninety-seven patients were hospitalized for ARF during this period (53 men, 44 women). The average age was 61.97± 21.189 with extremes ranging from 17 to 94 years old.

Among the causes of ARF, PAO, thoracic and cranial trauma accounted for 37.1, 26 and 14.4% respectively (Table I). The associated comorbidities were, in order of importance, hypertension (39.5%), diabetes (28.9%), heart disease (26.8%), stroke (6%), asthma (5.2%), chronic renal failure (5%), COPD (4.1%) and other neurological pathologies (4%).

Table I: The causes of AKI in the UMC department of CHU Oran from January 2015 toNovember2016

Causes	n (%)
OAP	36 (37, 1%)
Thoracictrauma	25 (26%)
Head injuries	14 (14, 4%)
State of shock	8 (8, 4%)
Respiratory diseases	8 (8, 1%)
COPD decompensation	4 (4, 4%)
Severe acute asthma	2 (2, 1%)
Pulmonary embolism	1 (1%)

Ventilatory assistance techniques were used in 50.5% of patients (49), NIV in 38.1% (37) and oxygen therapy in there maintaining 11.4% (11).

NIV was performed in 64.9% of patients with PAO, 10.8% with chest trauma, 8.1% with COPD decompensation, and equally in 2.7% of patients with asthma, lung disease, shock and head trauma. NIV was performed in CPAP mode in 65% (24 patients) of patients and in SV AI-PEP mode in theremaining 35% (13patients). NIV failure was observed in 12 of the 37patients, representing a frequency of 32.4%.

Among the factors: age, pulse oxygen saturation, presence or absence of heart disease, respiratory rate, Glasgow score, heart rate, systolic and diastolic blood pressure, the univariate analysis identified pulse oxygen saturation and diastolic blood pressure as factors for failure of NIV (table2).

Table II: Univariate analysis of NIV failure factors in the UMC department of CHU Oran from January 2015 to November 2016

Variable	P value
Age	0.428
SPO2onadmission	0.04
Heart disease	0.06
Respiratory frequency	0.423
Neurological condition	0.06
Heart rate	0.163
Systolic blood pressure	0.081
Diastolic blood pressure	0.02

4. Discussion

This study showed that NIV was used in 38% of patients hospitalized for ARF in the emergency department of the CHU Oran, a figure which varied in the literature.

A Study of 81 Massachusetts hospitals with no fewer than 1176 intensive care beds reported an overall incidence of NIV use of 20% of all MVs applied, but highlighted the great heterogeneity of this incidence between hospitals (less than10%to more than35% of MVs), as well as in the equipment used (masks, ventilators) [9]. Perrin and colleagues in their article published in June 2015 report a use rate of 47%. [10] A study carried out in France over a period of fifteen years (1997-2011) showed that ventilatory assistance was required in3, 163 patients. The proportion of NIV as the primary ventilatory modality was 31%: this proportion increased steadily over the study period from 29% to 42%, for the 4 indications considered: COPD exacerbation, cardiogenic PAO, de novo ARF in immunocompetent patients and de novo ARF in immunocompromised patients. At the same time, the success rate rise from 69% to 84% [11].

The most frequent indication was PAO, which is consistent

with the literature.

In fact, its use is certain, as shown by the recommendations of the 2006 national consensus conference [12], which make it a major indication. In this context, NIV provides a more rapid improvement in respiratory distress than pharmacological treatment alone, a reduction in the rate of intubation, and some studies report a reduction in mortality when NIV is applied as early as possible in the pre-hospital phase [13].

Cardiogenic pulmonary oedema and acute exacerbation of COPD now represent the elective indications for NIV, as shown by the study by Ram and Brochard and the meta-analysis by vital et al [14, 15, 16]. More than 30 prospective, randomized, controlled trials of NIV in COPD have systematically demonstrated physiological improvements in hypoxic and hypercapnic respiratory failure, and a significant reduction in the need for intubation. It has also been shown to reduce the duration of respiratory assistance, length of hospital stay and improve survival (RR95%CI=0.44-0.92) [17].

For Stefan M. S et al, in a large-scale study carried out between 2001 and 2011, the use of invasive ventilation fell by 3.2% annually, while the proportion of NIV as the initial ventilatory modality increased by around 15% annually [18].

CPAP was the most commonly used non-invasive support method in this series.

This technique was the most frequently reported for PAO, which was the most frequent, a etiology. This technique is indicated in cases of acute decompensation in chronic bronchopneumopathy, as the literature clearly illustrates [17]. In fact, the importance of NIV in this indication is now supported by at least 14 well-conducted prospective, randomized, controlled studies involving more than 600 patients. Most studies reported allow prevalence of side effects and a significant reduction in intubation rates and in-hospital mortality. A meta analysis of NIV trials showed significant reductions in mortality (95% CI, RR = 0.35-0.76) and the need for intubation (95% CI, RR=0.33-0.53) [18].

In our study, failure occurred in 30% of patients. Perrin and colleagues report rate of 26.5% [10].

The univariate analysis of failure factors in our series found that low SPO2 was the only failure factor. For Perrin, hypoxia and acidosis were the 2 factors identified for NIV failure.

For Sammer metabolic acidosis (odds ratio 1.27, 95% CI 1.03-0.07) and severe hypoxia (odds ratio1.03, 95% CI1.01-1.05) were retained as factors for failure of NIV [5].

The degree of acidosis associated with hyperglycemia has been identified by Moretti M et al [*19*]. For Soo Hoo al, the presence of leaks, lack of coordination with the ventilator and rapid improvement in the patient's clinical condition were the parameters that did not allow NIV to be successful [*20*].

We did not find age to be a risk factor for failure in our series, where as the multicentre study by Antonelli had shown that age over 40, diabetes, sepsis and the degree of hypoxia were at the origin of NIV failure [*21*]. Blood gases were rarely used in this series. An analysis of the literature shows that the values of the various blood gas parameters such as pH, PaO2 and PaCO2 were decisive in the failure or success of NIV. Blood gases are a determining factor in the management and monitoring of acute respiratory distress.

5. Conclusion

NIV is a technique and a therapeutic arsenal whose benefits in the management of ARF no longer need to be proven. There are many reasons why this ventilatory therapy should be offered to many patients with acute respiratory failure treated in emergency departments. Patients with decompensating COPD and those with severe PAO are those who should benefit most from very early initiation of NIV.

It is increasingly being used in patients with respiratory distress.

This non-invasive technique must be included in the protocols for managing this type of patient in the various emergency services throughout the country.

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