

Predicting Failure of Non-invasive Ventilation among patients admitted at ShethL.G.General Hospital, Ahmedabad, Gujarat, India- A retrospective study

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Abstract

Objective: Purpose of the study, is to find out if Non Invasive Ventilation (NIV) failure can be predicted, on the basis of the information available at initial point of a contact with patient.

Methods: This is the retrospective study of patients which were admitted to AMC MET Medical College, ShethL.G.General Hospital, Ahmedabad during the years 2014-2015. Patients were assigned, to one of the two groups covering the successful NIV treatment & NIV failure.

Results: 90 patients were incorporated in the study & two groups were compared on the variables accessible at initial point of contact with patient. Patients in which NIV treatment failed did have elevated levels of the C-reactive protein ($p=0.04$). Multivariate analysis showed that an odds ratio, of 1.13 for NIV failure; associated with increased respiratory rate. NIV was less likely to fail in patients with the recognized Chronic Obstructive Pulmonary Disease ($p=0.05$).

Conclusion: In this current study NIV failure, was found to be associated with the elevated levels of the C-reactive protein tended to have the elevated respiratory rates.

Key words: C-reactive protein, Multivariate analysis, Non Invasive Ventilation, Patient, Respiratory rate

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Methods

This is the retrospective study of the patients in acute respiratory failure admitted ICU at AMC MET Medical College, ShethL. G. General Hospital, Ahmedabad during the years 2014-2015. The patients were admitted to the ICU from all the departments of the hospital. Patients were excluded if because of either noninvasive or invasive ventilation was not a preference, at the first point of contact with patient. Exclusion was also done if insufficient data was available. All patients had a standardized panel of blood samples which were drawn upon coming. Samples for C-reactive protein & white blood cell count were drawn from the venous blood, while; rest were drawn from arterial blood. Ethical approval was taken from the institute.

Both groups were distinct as follows: Patients which were treated exclusively with NIV (NIV success) and patients initially treated with the NIV but subsequently, required sedation, intubation & the invasive ventilation (NIV failure). The primary endpoint was the NIV failure & the two groups were compared on variables; which were available at a point of the contact in turn to determine if it could be predicted that NIV would fail. The arterial blood gas (ABG), Systolic blood pressure and Temperature measurements were performed.

Introduction

In patients with preserved respiratory drive with acute respiratory failure (ARF), Non invasive ventilation is most often considered as first line of treatment^{1,2}. It is frequently used; both in and outside of intensive care unit (ICU). Invasive ventilation requires the endotracheal intubation and is most frequently associated with ventilator-associated pneumonia and different other complications which are related to the prolonged intubation. In some patients NIV is not sufficient & they subsequently require invasive ventilation. Various recent researches have shown that duration of NIV before intubation, was shorter in the survivors than the non-survivors³ among the patients who were not before diagnosed with cardiac or respiratory illness e.g. chronic obstructive pulmonary disease (COPD).

The objective of the present study is to establish that if NIV failures can be predicted on the ground of information that is accessible at the initial point of contact with the patient in acute respiratory failure at

Data was then analyzed using the independent sample t test, paired t test, and chi-square test. P-value which is less than 0.05 were considered as statistically significant.

Results

A total of 90 patients were included in the study. The patient characteristics of both groups are described in table 1. In this study 60 patients were, effectively treated with the NIV while 30 patients had to be invasively ventilated after NIV failure. To determine if NIV failure could have been predicted at initial point of contact a evaluation between NIV success and the NIV failure was then made. These variables are shown in table 2. In patients initially treated with NIV but requiring invasive ventilation there was a leaning toward a higher ICU mortality and higher in-hospital mortality compared to the patients effectively treated with NIV. There was a significantly lower percentage,

of NIV failure amongst the patients diagnosed with COPD. Multivariate analysis showed an odds ratio (OR) for NIV failure with improved respiratory rate of 1.13 while higher levels of C-reactive protein had an OR: 1.01.

The variables within, NIV failure group were compared at the initiate of NIV to the values when the patient was intubated and invasively ventilated to explore if a worsening was measurable. These results are presented in table 3. Blood samples for CRP and WBC were drawn, once a day and since the mean duration of NIV prior to intubation was 14.1 hours. These parameters remained unchanged for majority of the patients. Among patients intubated after non-invasive ventilation there was no statistically significant difference in period of NIV among the ICU survivors and non-survivors or between in-hospital survivors and non-survivors.

Table 1: Demographic data of patients

Variable	Niv success	Niv failure	P value
Sex (Male: Female)	22:37	14:16	0.26
Age (mean), years	70.5	70.3	0.92

Table 2: evaluation of patients, treated exclusively with NIV (NIV success) and patients requiring invasive ventilation after NIV was attempted (NIV failure)

	Niv success		Niv failure		P value
	Mean	SD	Mean	SD	
Ph	7.23	0.12	7.23	0.13	0.85
Lactic acid	2	2.1	1.4	0.9	0.09
C-reactive protein (CRP)(mg/L)	79	91	138	113	0.001
White Blood cell Count(WBC)(10⁹/L)	13.4	5.4	12.3	6.7	0.25
Systolic blood pressure (mmHg)	131	36	120	26	0.11
Heart rate (min-1)	110	19	107	29	0.55
Respiratory rate (min-1)	27	8	30	09	0.09
Temperature (°C)	37.2	0.93	37.3	1.3	0.58

Table 3: Patients in NIV failure group at the initiation of NIV & at initiation of invasive ventilation

	Initiation of non-invasive ventilation		Initiation of invasive ventilation		P value
	Mean	SD	Mean	SD	
Ph	7.23	0.12	7.23	0.13	0.45
Lactic acid	1.4	0.9	2.8	1.3	0.54
Systolic blood pressure (mmHg)	121	32	105	20	0.02
Heart rate (min-1)	107	29	97	25	0.09
Respiratory rate (min-1)	30	9	25	10	0.001
Temperature (°C)	37.4	0.98	37.2	1.4	0.58

Discussion

In this present study NIV failure was associated with the increased plasma levels of C-reactive protein. Anton Elli et al.⁴ found, that NIV was more likely to fail in patients presenting with community-acquired pneumonia. As describe in the table 2 none of other markers usually connected, with infection showed statistically significant differences. However in neither group was CRP nor WBC within the standard limits, signifying there were patients in both groups with infection e.g. CAP. Any symbol of CAP, when using non-invasive ventilation should on time a high degree of vigilance in regulate to notice signs of NIV failure as is in suggested by Ferreretal.⁵ and elevated CRP in the present study supports this. There was a tendency to higher respiratory rate (RR) being linked to NIV failure and multivariate analysis showed an OR of 1.13. In the study by Anton Elli et al.⁴ a respiratory rate ≥ 38 show an OR for NIV failure of 1.89. An association between the Glasgow Coma Scale (GCS) score and NIV failure has been shown by Schettino et al.⁶. Schettino et al take big care in assuring consistent scoring but there is a risk of interobserver variation⁷. Between the two groups there was no significant difference in GCS score & it seems unsuitable as the single basis for treatment decisions.

In the present study known that the COPD was associated to a lower occurrence of NIV failure with the numbers matching the study by Carrillo et al.³ that found that patients with “de-novo” ARF failed more frequently.

Among patients with “de novo” ARF longer duration of NIV prior to intubation was shown to be associated with the decreased hospital survival.⁸ The time of NIV that best predicted mortality was ≥ 53 hours with the sensitivity of 69% and a specificity of 83%. In patients with acute lung injury Rana et al;⁹ establish that the non-survivors tended to have a longer postponement in the intubation although this was not statistically significant. In the current study neither the ICU nor the in-hospital mortality was connected with the duration of non-invasive ventilation prior to intubation. When comparing, values of the variables at the initiation of NIV to the values at the initiation of invasive ventilation, table 3 shows a significant increase in oxygen saturation and a reduction in the respiratory rate. This would specify that patients were in some ways more steady but there was no development in gas exchange. In the present study the mean time of non-invasive ventilation prior to intubation was 14.1 hours and decline of the patients was not diagnosed with the selected variables. It seems however, reasonable to assume that further prolonging NIV before intubation, would have yielded a measurable deterioration and lesser survival rates.

This study is of course restricted by its retrospective nature premature administration of supplemental oxygen makes it more difficult to

differentiate between hypoxic and hypercapnic respiratory failure. Variables such as GCS and respiratory rate can show, inter observer variation as mentioned former when measuring durations of ventilation this was done in one hour intervals & thus carries an inaccuracy.

Conclusion

Patients requiring intubation due to NIV failure had higher levels of C-reactive protein & tended to have higher respiratory rates. The literature shows indications, of the detrimental effect of NIV failure & further studies, are required in order to select the right treatment at the initial point of contact in the patient with acute respiratory failure.

Conflict of Interest: None

Source of Support: Nil

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