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Original Research Article

Outcome Assessment of Patients of Non-CF Bronchiectasis Admitted with ARF and Managed with NIV as a Primary Mode of Ventilatory Support: An Analytical Observational Study

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Abstract

Aim: The purpose of the present study was to assess the outcome of patients of non-CF bronchiectasis admitted to our institute with ARF and managed with NIV as a primary mode of ventilatory support. We also compared various physiological and clinical parameter between NIV and mechanical ventilation.

Methods: The present study was conducted in the Department of emergency and Critical Care(Trauma and Emergency), IGIMS, Patna, Bihar, India for one year . There were a total of 250 patients with bronchiectasis who were admitted during the above specified period. Among these, 130 patients were admitted with ARF. Totally, 120 patients who required either NIV or IMV.

Results: The most common etiology of bronchiectasis was post-tuberculosis (66.66%) followed by idiopathic (16%), ABPA (11.12%), and immunodeficiency (5.55%). NIV was initiated as first line of ventilator support for 90 patients. Among these, 60(66.66%) were managed successfully with NIV. 30 (33.34%) patients failed NIV and required endotracheal intubation during the hospital stay.

Conclusion: Our results suggest that utility of NIV should to be assessed in well-designed prospective studies for ARF in non-CF bronchiectasis patients.

Keywords: Acute respiratory failure, mechanical ventilation, noncystic fibrosis bronchiectasis, non-invasive ventilation

Introduction

Although the efficacy of non-invasive ventilation (NIV) in reducing the need for endotracheal intubation and mortality has been clearly established, its failure rate remains high, exceeding 20% in patients without COPD. [1,2] A high mortality rate has been recently reported in a large group of patients who, following unsuccessful

treatment with NIV, required subsequent application of invasive mechanical ventilation. [2] Non-cystic fibrosis bronchiectasis is a progressive condition generally associated with chronic bacterial infections and characterized by irreversible destruction and dilation of the airways. [3] The clinical course of individuals with non-cystic fibrosis bronchiectasis is variable, with a significant proportion of patients developing transient exacerbation leading to severe acute respiratory failure (ARF) and requiring ventilatory support. [4] Although the use of NIV in bronchiectasis exacerbations may appear attractive as it can reduce ICU stay, its failure rate exceeds 25%. [5] At the same time, subsequent application of invasive mechanical ventilation, which is associated with a mortality rate of 19 –35% and prolonged ICU stay, appears problematic. [6]

Patients with non-CF bronchiectasis often die of causes related to bronchiectasis and acute respiratory failure (ARF). [7,8] Its usual clinical features include chronic cough and viscid sputum production. Non-cystic fibrosis (CF) bronchiectasis is a disease of heterogeneous etiologies. It was once considered as an orphan disease, however currently it is not so. [9,10] Only in some patients of non-CF bronchiectasis, specific treatment directed to the underlying condition such as allergic bronchopulmonary aspergillosis (ABPA), mycobacterial infection, or immune deficiency may be required. However, in most of the patients, treatment is nonspecific limited to chest physiotherapy to clear the viscid sputum and antibiotics therapy to control the infection, reducing inflammation, and improving bronchial hygiene. Acute worsening and respiratory failure leading to emergency visit and hospitalization is not uncommon among these patients. [11,12]

Over the last few years, noninvasive ventilation (NIV) has been used successfully for treatment of acute respiratory failure (ARF) due to various diseases without the need for endotracheal intubation and its complications. [13,14] For chronic obstructive pulmonary disease (COPD), NIV is the “standard of care” for management of ARF. [14,15] Bronchiectasis has many features similar to COPD. However, data regarding the use of NIV for treatment of ARF among patients with bronchiectasis are limited. [16]

The purpose of the present study was to assess the outcome of patients of non-CF bronchiectasis admitted to our institute with ARF and managed with NIV as a primary mode of ventilatory support. We also compared various physiological and clinical parameters between NIV and mechanical ventilation.

Materials and Methods

The present study was conducted in the Department of emergency and Critical Care(Trauma and Emergency), IGIMS, Patna, Bihar, India for one year .There were a total of 250 patients with bronchiectasis who were admitted during the above specified period. Among these, 130 patients were admitted with ARF. Totally, 120 patients who required either NIV or IMV.

Inclusion criteria

- Patients with bronchiectasis
- Patients who were admitted with ARF and required either NIV or invasive mechanical ventilation (IMV)

Exclusion criteria

- Patients with bronchiectasis who required admission for reasons other than ARF were excluded.
- Patients who had ARF but managed with oxygen

For etiology of bronchiectasis, all patients admitted under pulmonary medicine are routinely evaluated for ABPA, CF, connective tissue disease, mycobacterial infection, and immune deficiency. If the

clinical and laboratory workup is negative then it is labeled as idiopathic. For this study, the final diagnoses at the time of discharge were used to classify the etiology of bronchiectasis.

ARF was diagnosed based on the history of acute worsening of cough, breathlessness, respiratory distress or cyanosis and arterial blood gas (ABG) analysis showing either PaO2 <60 mmHg or PaCO2 >45 mmHg.

NIV start with inspiratory positive airway pressure (IPAP) of 8–10 cm of H2O and expiratory positive airway pressure of 4–6 cm of H2O. The patient is closely monitored for clinical stability /improvement, and IPAP is adjusted accordingly. The IPAP is increased by 2–4 cm of H2O every 5–10 min while observing the use of accessory muscles, respiratory rate, and comfort of the patient. Oxygen is given to keep oxygen saturation between 88% and 92%. If the patient does not improve even with IPAP of 20 cm of H2O or develop intolerance at any IPAP, we switch to endotracheal intubation and mechanical ventilation. Furthermore, if the patient develops any signs of failure or contraindication of NIV such as hemodynamic instability, decreased mental status, and worsening respiratory acidosis at any time during NIV treatment, we will intubate and start mechanical ventilation. Those patients who stabilized with NIV were treated with NIV for the maximum duration on day 1, allowing breaks for meals and nebulization. Once patient recovered from the acute illness, weaning from NIV is accomplished by gradually increasing the off NIV periods as recommended by the British Thoracic Society.[17]

Statistical analysis

The data were summarized and analyzed using. Data were expressed as mean ± standard deviation, median with range or in number and percentage as appropriate. Data were tested for normality using the Kolmogorov–Smirnov test. An independent sample Student's t-test was used to compare the parametric values. For comparison of categorical data, the Chi-square test/Fisher's exact test was used to establish the association. To find the early predictor of NIV failure, univariate and multivariate analyses were performed to compare various clinical and ABG parameters between patients who were successfully managed with NIV as compared to who failed NIV. One way analysis of variance analysis was done for more than two groups with Bonferroni correction. $P < 0.05$ was considered to represent statistical significance for the study.

Results

There were a total of 250 patients with bronchiectasis who were admitted during the above specified period. Among these, 130 patients were admitted with ARF. Totally 120 patients who required either NIV or IMV. The most common etiology of bronchiectasis was post-tuberculosis (66.66%) followed by idiopathic (16%), ABPA (11.12%), and immunodeficiency (5.55%). The baseline characteristics of these patients are shown in Table 1.

Table 1: Demographic profile of the patients

Parameters	NIV (n=90)	IMV (n=30)
Age (years), mean±SD	48.60±20.12	52.18±16.32
Gender male, n (%)	60 (66.66)	18(60)
APACHE, mean±SD	14.28±4.32	17.12±6.36
Associated COPD, n (%)	10 (11.11)	6(20)
Reason for exacerbation, n (%)		
Infective	75 (83.33)	20 (66.66)
Non-infective	15 (16.67)	10 (33.34)

Etiology		
Post-tuberculosis	60 (66.66)	20 (66.66)
Idiopathic	15 (16.67)	5 (16.67)
ABPA	10 (11.12)	3 (10)
Immunodeficiency	5 (5.55)	2 (6.67)
Arterial blood gases at the time of admission (mean±SD)		
pH	7.50±0.088	7.20±0.22
PaCO2 (mmHg)	77.87±19.36	84.36±20.88
PaO2 (mmHg)	72.76±32.82	68.30±18.55
Bicarbonate (mmHg)	32.12±6.12	27.89±7.45
Oxygen saturation (%)	86.10±7.50	88.48±8.60

NIV was initiated as first line of ventilator support for 90 patients. Among these, 60(66.66%) were managed successfully with NIV. 30 (33.34%) patients failed NIV and required endotracheal intubation during the hospital stay. NIV failure occurred after a median duration of 2.77(95% confidence interval [CI]1.51–4.24) days after the initiation. There were total 10 deaths in the study group. Among patients who failed NIV, total days (median [range]) spent on ventilator (6.6 [2–62] vs. 6.1 [3–16] days; P = 0.41), duration (median [range]) of hospital stay (8 [4–64] vs. 11 [5–15] days; P = 0.27), and mortality (8 [10%] vs. 3 [15%]; P = 0.24) were comparable to the IMV group. The causes of death among patients who failed NIV were septic shock (n = 5) and ventilator-associated pneumonia (n = 5). Predictors of noninvasive ventilation failure: For identification of the early predictors of NIV failure univariate and multivariate regression analysis was performed using various baseline clinical and laboratory parameters of patients managed successfully with NIV and who failed NIV. The results are summarized in Table 2.

Table 2: Univariate and multivariate analysis for predictors of noninvasive ventilation failure

Parameter	OR (95% CI)	P value	OR (95% CI)	P value
Age (years)	1.15 (0.95-1.05)	0.90	-	-
Gender	0.61 (0.19-1.49)	0.39	-	-
APACHE score	1.17 (1.11-1.41)	0.001	1.17(1.11-1.41)	0.003
Blood gases at admission				
pH	0.026 (0.006-4.89)	0.29	-	-
PaCO2 (mmHg)	1.07(0.94-1.05)	0.57	-	-
PaO2 (mmHg)	1.05(1.06-1.07)	0.03	1.05 (1.06-1.037)	0.04
Bicarbonate(mmHg)	0.98(0.94-1.08)	0.80	-	-
Oxygen saturation (%)	1.07(0.94-1.11)	0.40	-	-

Discussion

Non-invasive ventilation (NIV) has been recognized as a means to avoid intubation during ARF and to reduce the risk of complications, such as ventilation-associated pneumonia, especially in immunosuppressed patients. [18] Our study results have shown that NIV as the "primary modality" of ventilatory support is feasible for treatment of ARF among patients with non-CF bronchiectasis. Its use was associated with success rate of 65%. The correction of various ABG parameters using NIV at various time intervals was comparable to that of IMV.

There were total 10 deaths, 7 in NIV and 3 in IMV group. [17]

The successful use of NIV as shown in this study highlights that in almost two-third of the patients with bronchiectasis and ARF the endotracheal intubation may be avoided. Phua et al. reported their experience with NIV for management of 31 patients of non-CF bronchiectasis with ARF. [16] Their success rate of NIV was comparable to our study (67% vs. 68%). One of the reasons for not using NIV in patients with bronchiectasis may be the presence of copious amount of sputum. Inability to handle respiratory secretions is one of the contraindications for NIV use. [14,15]

However, it should be noted that in this study none of the patients failed NIV due to excessive secretions. These results were consistent with the previous study in which also no patient failed NIV due to inability to handle respiratory secretions. [16]

However, it should be noted that in this study none of the patients failed NIV due to excessive secretions. These results were consistent with the previous study in which also no patient failed NIV due to inability to handle respiratory secretions. [16] Normalization of the physiological parameters such as blood gas values is also one of the goals of ventilatory support. [19]

Faster the normalization of these parameters and early weaning may avoid all these. IMV, due to better control on set variables, is expected to correct both ventilatory and oxygen parameters faster than NIV. However, our study has shown that the various ABG parameters at different time intervals were comparable between patients on NIV and IMV. These results indicate that the rate of correction of ABG parameters similar to IMV may be achieved with NIV without potential complications associated with endotracheal intubation. One observation in this study which needs to be discussed is the NIV failure. Failure rate of NIV described in patient with COPD and ARF was approximately 20%. [20]

When multiple regression model was applied only high APACHE score was associated with NIV failure (odd's ratio [95% CI]: 1.17 (1.11-1.41)]). [21] These results indicate that APACHE score may be used as a predictor of NIV failure for these patients. Other studies also reported the predictors of NIV failure which included APACHE score, worse hypercapnia, and hypoxemia[16,6,24]. In our study, PaCO2 and PaO2 at baseline and at 2 h were similar in both groups. Our study also showed that the duration of hospital stay and time spent on ventilator by patients who failed NIV were comparable with the patients who received IMV as first-line management strategy. This implies that the failure of initial trial of NIV among these patients did not impart additional risk of adverse outcome in these patients. This is one of the largest studies describing the outcome of NIV use in patients with non-CF bronchiectasis and ARF.

Conclusion

The present study showed that NIV is feasible and may be used in two-third of patients with non-CF bronchiectasis and ARF. High APACHE at the time of admission may predict the failure of NIV. Failure of NIV did not lead to worse outcome compared to the use of IMV as initial mode of ventilation. Our results suggest that utility of NIV should to be assessed in well-designed prospective studies for ARF in non-CF bronchiectasis patients.

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