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Original Article

Internal Medicine Section

A Study of Indications and Outcome of Non-Invasive Ventilation in Respiratory Care Unit of a Tertiary Care Hospital in Eastern India

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ABSTRACT

Introduction: Patients with Acute Respiratory Failure (ARF) can be ventilated noninvasively through Bi-Level Positive Pressure Ventilation (Bi-PAP). The proper timing, indications and outcome of Non-invasive Ventilation (NIV) have been evaluated worldwide by many investigators. Optimum selection of patients leads to better outcome reducing need for invasive ventilation; while the reverse can cause inappropriate delay in intubation leading to clinical deterioration, increased morbidity and mortality.

Aim: To evaluate the indications and outcome, with relevant factors in all patients requiring NIV in Respiratory Care Unit (RCU) of a teaching hospital.

Materials and Methods: This was a hospital-based observational study conducted from April 2016 to March 2017. After ethical approval, all patients who were put on NIV in RCU of the institution during the period of one year were enlisted. Evaluation by history, detailed clinical examination and necessary investigations including blood count, biochemistry, Arterial Blood Gas (ABG) analysis, oxymetry, microbiological investigations, imaging of thorax etc., was done. Examination and investigations were periodically repeated as necessary. Pre-fixed NIV protocol and end point definitions were followed. Descriptive statistics done using Mean and Standard Deviation (SD). Mann-Whitney U test was done for comparing quantitative data. Chi-square test or Fisher's-exact test was used to compare categorical data.

Results: Most common age group for Respiratory Failure (RF) was 41 to 60 years, (mean 56.5±11.6), with a male predominance (M:F=1.4:1). The most common underlying disease leading to RF and requiring NIV support was Acute Exacerbation of Chronic Obstructive Pulmonary Disorder (COPD) (n=31) in Type 2 and pneumonia (n=11) in Type 1 RF. Hypertension (25%) and diabetes mellitus (20%) were common co-morbidities. Favourable outcome was seen in 68.33% patients an average hospital stay of 15 days. The baseline APACHE-II (Acute Physiology and Chronic Health Evaluation) score ($p \leq 0.0001$) and Partial Pressure of Oxygen(PaO_2)/ Fraction of Inspired Oxygen (FiO_2) at 1st hour of NIV ($p=0.0054$) have significant predictive value the outcome. Reasons for shifting to IMV were: non-improvement of ABG (37.93%), worsening of dyspnoea (24.14%) and haemodynamic instability (20.7%). Average time gap from initiation of NIV to mechanical ventilation in failure cases was 8.03 hours in Type 2 RF and 5.78 hours in Type 1 RF. Fatality rate in Type 2 RF (23.68%) was much less than in Type 1 RF (45.45%).

Conclusion: This study strengthens the fact that efficient utilisation of NIV therapy in properly selected patients of acute RF can lead to reduced need for IMV, thus reducing the cost and complications. Disease severity at admission (APACHE-II score), non-improvement of ABG parameters in 1st and 4th hour of NIV initiation, PaO_2/FiO_2 ratio, development of haemodynamic instability and deteriorating level of consciousness, all play pivotal roles in the outcome assessment.

Keywords: Positive pressure ventilation, Respiratory care unit, Respiratory failure

INTRODUCTION

Non-Invasive Ventilation (NIV) is delivered via oronasal mask. It is an effective technique of providing ventilation without introduction of an artificial airway [1]. Patients with ARF can be ventilated non-invasively through NIV. It reduces the need for endotracheal intubation and thereby reduces associated complications like airway trauma, pneumonia etc. NIV has been evaluated in diverse settings of ARF (both Type 1 and 2) with an aim to reduce duration of ICU stay and overall cost of hospitalisation [2]. NIV is currently considered the standard of care for exacerbations of COPD [3]. The timing and indications for initiation of NIV has been evaluated by many investigators. Early commencement of NIV in appropriate patients is associated with better outcome and can reduce the need for invasive ventilation [4]. While some patients will initially benefit from NIV but then later deteriorate and require intubation [5]. Patients that may fail with NIV need to be identified early to avoid a downhill clinical course leading to increased mortality and morbidity by delay in initiating mechanical ventilation.

This study intended to innumerate the indications for NIV and the different outcomes in all these patients; who were admitted in RCU of a Tertiary Care Teaching Hospital in Eastern India during the study period of one year.

MATERIALS AND METHODS

This was a hospital-based observational study. Necessary approval was taken from the Institutional Ethics Committee with concerned university (approval number: OG/DEAN/WBUHS/2016-17/01) and informed consent was obtained from all the patients. Patients that were admitted in RCU of Respiratory Medicine Department of the hospital and put on NIV; during a period of one year, from April 2016 to March 2017 were enlisted for the study. The sample size was calculated to be approximately 42; given a proportion of 71.4% and null hypothesis value of 50%. Patients who were: agitated/obtunded/confused/non-cooperative, haemodynamically unstable (SBP<90 mmHg, ventricular arrhythmia etc.), those with recent facial/upper airway deformity/trauma/surgery/burns, poor cough reflex, un-drained pneumothorax, intestinal obstruction, unwilling to give consent etc., were excluded from the study.

The enlisted patients were evaluated with detailed history-taking, clinical examination, necessary investigations including blood

count and biochemistry, ABG analysis, oxymetry, microbiological investigations like sputum bacteriology, blood culture, imaging with Chest X-ray, CT and ultrasonography of thorax (where applicable). Clinical examination and investigations were periodically repeated as necessary from time to time.

End point for an individual case was judged based on: (a) failure of NIV needing intubation; (b) successful improvement with NIV and discharge; (c) case fatality. Some objective parameters were taken into account for follow-up assessment: (a) duration of RCU and hospital stay; (b) change of ABG and clinical parameters; (c) maximum I-PAP/E-PAP (inspiratory/expiratory positive airway pressure) needed, (d) time taken for maximum EPAP/IPAP from initiation of NIV; (e) time span between starting of NIV to endotracheal intubation (if applicable).

Following were taken as criteria for considering failure/stopping of NIV and stepping into invasive ventilation: (a) failure of improvement in clinical and gas exchange parameters in one hour; (b) development of alteration of sensorium; (c) occurrence of haemodynamic instability (Heart Rate (HR) <60/min, systolic blood pressure <90 mm Hg, arrhythmias); (d) intolerability of face mask.

The NIV protocol was as follows: to start NIV at IPAP of 7-8 cm H_2O and EPAP of 3-4 cm H_2O via oro-nasal mask which was gradually increased by 2 cm H_2O IPAP and 1 cm H_2O EPAP. Patients were routinely observed and data recorded on 1st and 4th hours of NIV initiation and thereafter, as and when required till clinical response in the form of: (a) relief of dyspnoea; (b) betterment of ABG; (c) reduction of Respiratory Rate (RR<30/ min); (d) SpO_2> 92% achieved or a maximum IPAP/EPAP of 20/10 cm H_2O was reached. During the initial 24 hours, disconnection of NIV was only allowed for food intake or to clear oral secretions. Thereafter, the period of "NIV-off" was gradually increased till patient could maintain SpO_2> 92% in room air and RR <30/min.

STATISTICAL ANALYSIS

After data collection descriptive statistics was done using Mean, SD and frequency distribution tables. Data was analysed using the Statistical Package for Social Sciences (Windows version 10.0; SPSS Inc, Chicago {IL}). Mann-Whitney U test was used for comparing quantitative data. Chi-square test or Fisher's-exact test was used to compare categorical data. Statistical significance was inferred at p-value of <0.05.

RESULTS

A total of 620 admissions took place during the study period in RCU and Respiratory medicine ward. Out of these, 60 patients needed NIV support, either since admission or in due course.

Demographic parameters were shown in [Table/Fig-1]. Mean Age of the study group was 56.5 years (SD=11.6 years). The most common age group was 41-60 years. The male to female ratio was 1.4:1 (Male=35 and Female=25). Overall, 46.67% patients had co-morbidities. Some patients had multiple co-morbidities. Hypertension (25%) and diabetes (20%) were the most common co-morbidities. The most common presenting complaint was breathlessness.

Out of 60 patients, 22 (36.67%) had Hypoxemic RF (Type I RF); while 38 (63.33%) had Hypercapnic RF (Type II RF). Type I RF was reported in patients with Pneumonia (n=11, 18%), Acute Respiratory Distress Syndrome (ARDS) (n=3, 5%) and Interstitial Lung Disease (ILD) (n=8, 13%). Type II RF was seen in patients with Acute exacerbation of COPD (n=31, 52%), Asthma-exacerbation (n=2, 3%) and patients who underwent NIV with a history of extubation from mechanical ventilation very recently, and thereby avoiding re-intubation in a high risk patient (n=5, 8%). The most common causes of hypoxemic (Type I) and hypercapnic (Type II) RF were Pneumonia and AECOPD respectively, with an overall predominance of AECOPD.

Serial number	Demographic variable		Number of patients (n=60)	% of patients
A.	Gender	Male	35	58.33%
		Female	25	41.67%
B.	Age	≤40	5	8.33%
		41-60	30	50%
		61-80	22	36.67%
		>80	3	5%
C.	Smoking	YES	40	66.67%
		NO	20	33.33%
D.	mMRC grade	0-2	24	40%
		3-4	36	60%
E.	Co-morbidity	YES	28	46.67%
		NO	32	53.33%
Different types of co-morbidity		Hypertension	15	25%
		Diabetes mellitus	12	20.0%
		Ischemic heart disease	4	6.67%
		Pulmonary hypertension	4	6.67%
		Obstructive sleep apnoea	1	1.67%
		Chronic liver disease	0	0%
		Chronic renal disease	2	3.33%
F.	Prior hospitalisation	YES	15	25%
		NO	45	75%

[Table/Fig-1]: Demographic and clinical-presentation (symptomatology, co-morbidity etc.,) data of the study population.

The baseline parameters of the patients at initiation of NIV were shown in [Table/Fig-2]. Patients with hypercapnic RF were older and there was a difference in baseline HR, RR, pH, and PaO_2, $PaCO_2$, HCO_3 etc., between the two groups. Male predominance was seen among Type I RF, while almost equal gender distribution was seen among Type II RF patients. All patients received appropriate medical management in addition to the NIV.

Baseline parameters (mean value)	Hypoxaemic failure (Type I) n=22	Hypercapnic failure (Type II) n=38	p-values	Total n=60
Age (years) mean±SD	51.83±13.94	59.2±9.52	0.0182	56.5±11.49
Male	15 (68.18%)	20 (52.63%)		35 (58.34%)
Female	7 (31.82%)	18 (47.36%)		25 (41.66%)
Respiratory Rate (per minute) mean±SD	45.5±5.32	34.45±4.19	<0.0001	38.5±7.12
Heart Rate (per minute) mean±SD	122.5±7.36	115.39±5.12	<0.0001	118.0±6.88
pH; mean ±SD	7.48±0.024	7.32±0.034	<0.0001	7.37±0.083
PaO_2 (mm of Hg) mean±SD	38.05±8.14	46.30±5.88	<0.0001	43.27±8.09
$PaCO_2$ (mm of Hg) mean±SD	27.01±3.78	67.78±11.62	<0.0001	52.60±21.66
HCO_3 (mmol/L) mean±SD	20.90±2.31	33.65±5.08	<0.0001	28.97±7.48

[Table/Fig-2]: Baseline parameters of all enlisted patients that received NIV.

The follow-up parameters were shown in [Table/Fig-3]. There was significant improvement in HR and RR along with ABG parameters after 1 and 4 hours compared to initial parameters. The values improved to a greater extent in patients with hypoxemic (Type I) RF, compared to hypercapnic (Type II) RF.

Details of the outcome of NIV patients of diverse aetiology were shown in [Table/Fig-4]. Outcome was altogether better in Type II RF than Type I. The overall failure rate of NIV in this study was 48.33%. A total of 29 patients had to undergo IMV {63.36% (n=14) in Type I RF and 39.47% (n=15) in Type II RF}. Among Type II RF for COPD, the success rate clearly superseded failure rate; while NIV showed

Parameters	Follow-up observation '1st' hour			Follow-up observation '4th' hour		
	Type 1 RF	Type 2 RF	p-value	Type 1 RF	Type 2 RF	p-value
Heart rate (per minute) Mean±SD	115.36±7.76	111.92±7.19	0.088	110.72±8.10	106.06±12.51	0.1231
Respiratory rate (per minute) Mean±SD	36.7±5.65	31.59±5.13	0.0007	35.4±6.36	29.15±5.47	0.0002
pH Mean±SD	7.47±0.024	7.33±0.029	<0.0001	7.45 ±0.028	7.34±0.035	<0.0001
PaO_2 (mm of Hg) Mean±SD	60.4±9.30	58.50±6.26	0.3485	73.54±12.16	65.79±12.15	0.0206
$PaCO_2$ (mm of Hg) Mean±SD	36.90±4.96	64.68±12.27	<0.0001	38.90±4.55	60.56±15.66	<0.0001

[Table/Fig-3]: Follow-up parameters of respiratory failure patients (both Type-1 and Type-2 RF) under NIV.

	Aetiology	Success	Failure
Type 1 RF (n=22)		8 (36.37%)	14 (63.63%)
	Pneumonia (n=11)	6 (54.54%)	5 (45.45%)
	ALI/ARDS (n=3)	0	3 (100%)
	ILD (n=8)	2 (25%)	6 (75%)
Type 2 RF (n=38)		23 (60.52%)	15 (39.47%)
	AECOPD (n=31)	16 (51.61%)	15 (48.38%)
	Asthma exacerbation (n=2)	2 (100%)	0
	Weaning after IMV (n=5)	5 (100%)	0

[Table/Fig-4]: Outcome of patients on NIV.
ALI: Acute lung disease; ARDS: Acute respiratory distress syndrome; AECOPD: Acute exacerbation of chronic obstructive pulmonary disease

good success rates in asthma cases and in cases of repeated RF episode after initial successful weaning from IMV. Almost similar success and failure rates were also seen in pneumonia cases causing Type I RF; while in ARDS cases the picture was grim; NIV failed in all 29 patients that had to undergo IMV. Following were found as indicators of NIV failure: 37.93% (n=11) had non-improvement/worsening ABGs; 24.14% (n=7) had increasing dyspnoea, 20.7% (n=6) cases had haemodynamic instability and 17.25% (n=5) showed deterioration of level of consciousness.

Outcome related parameters during hospital stay were shown in [Table/Fig-5]. The time span since initiation of NIV to intubation for IMV was 6.84 hours for the entire overall study population. It was 5.78 hours in Type I RF and 8.03 hours in Type II RF. 50% of Type I RF patients who had NIV failure and subsequent invasive ventilation evolved within a time span of 5 to 10 hours; while 42.8 % patients had it within less than 5 hours' time from NIV initiation. Whereas in case of Type II RF patients that had failed with NIV and had to switch to IMV mostly (51.72%) had a shorter time of less than 5 hours; while in 34.48% patients 5 to 10 hours was needed.

Parameters	Hypoxemic (Type I) RF (N=22)	Hypercapnic (Type II) RF (N=38)	Total (N=60)
Endotracheal intubation (%)	14 (63.63%)	15 (39.47%)	29 (48.33%)
Time to Endotracheal intubation (hour) mean±SD	5.78±1.91	8.03±8.54	6.84±6.38
Duration of hospital stay (days)* mean±SD	14.2±3.55	15.3±3.09	15.01±3.25
Time to Max. IPAP (hour) mean±SD	2±0.82	2±0.84	2±0.84
Time to Max. EPAP (hour) mean±SD	1±0.5	1±0.41	1±0.43
Max. IPAP (cm of H_2O) mean±SD	12.6±1.71	14.4±2.05	13.86±2.10
Max. EPAP (cm of H_2O) mean±SD	6.2±1.19	5.2±1.27	5.56±1.31
Hospital mortality (%)	10 (45.45%)	9 (23.68%)	19 (31.66%)
Time of initiation of IMV			
1 to 4 hours	6 (42.8%)	9 (60%)	15 (51.72%)
5 to 10 hours	7 (50%)	3 (20%)	10 (34.48%)
11 to 24 hours	1 (7.14%)	2 (13.34%)	3 (10.34%)
24 to 48 hours	0	1 (6.67%)	1 (3.44%)
More than 48 hours	0	0	0

[Table/Fig-5]: Outcome related parameters during hospital stay.
*values are mean values and excluding case fatality

Different demographic, clinical and blood parameters and their relation to NIV success or failure are shown in [Table/Fig-6]. Among them, some significantly influenced the outcome like: grade of dyspnoea (p=0.0012), GCS score (p=0.0001), WBC count (p=0.0022), serum creatinine (p≤0.0060) and serum urea, sodium, potassium (all p<0.0001). Accordingly, greater the dyspnoea grade, higher was the failure rate; lesser the GCS score, higher was the failure rate and so on.

Parameters	NIV Success n=31	NIV Failure n=29	p-value
Age (in years) mean±SD	53.23±10.40	59.97±11.60	0.023
mMRC grade*	2.35±0.89	3.10±0.66	0.0012
Co-morbidity (%)	13 (41.93%)	15 (51.72%)	0.003
Blood WBC count (/c mm)	10850±2087.88	13250±2857.97	0.0022
Serum Sodium (mEq/L)	136.25±4.70	130.72 ±3.58	**<0.0001**
Serum Potassium (mEq/L)	4.04±0.43	3.03±0.62	**<0.0001**
Serum Calcium (mEq/L)	9.03±0.41	8.60±0.48	0.1777
Serum Urea (mg/dL)	28.45±6.50	37.72±6.26	**<0.0001**
Serum Creatinine (mg/dL)	0.87±0.18	1.01±0.20	0.0060
Serum Albumin (gm/dL)	3.10±0.32	2.85±0.33	0.0698
Glasgow Coma Scale (GCS)	13.38±1.40	11.44±2.02	0.0001

[Table/Fig-6]: Different variables and their relation to NIV success or failure.
*mMRC=modified Medical Research Council grading of dyspnoea

Success rate of NIV in hypoxemic RF was more when baseline APACHE-II score was less, (Mean ±SD for success was 16.25±1.39). Similarly, for hypercapnic RF success rate was more when baseline APACHE-II score was less (Mean±SD for success was 18.34±3.47). On the other hand, the lesser the PaO_2/FiO_2 value at 1 hour following NIV, greater were the chances of failure and vice versa [Table/Fig-7].

Baseline APACHE II score and its impact on outcome; Mean±SD	Hypoxemic RF		Hypercapnic RF	
	Success (n=08)	Failure (n=14)	Success (n=23)	Failure (n=15)
	16.25±1.39	**26±3.02**	**18.34±3.47**	**25±3.36**
PaO_2/FiO_2 at 1 hour of NIV				
≤145	0	11 (78.57%)	1 (4.34%)	1 (6.67%)
>145	8 (100%)	3 (21.42%)	22 (95.65%)	14 (93.3%)
≤175	1 (12.5%)	12 (85.71%)	5 (21.73%)	7 (46.67%)
>175	7 (87.5%)	2 (14.28%)	18 (78.26%)	8 (53.33%)
p-value	<0.0001		0.0054	

[Table/Fig-7]: Impact of Baseline APACHE II score and PaO_2/FiO_2 scores at 1 hour on outcome ofpatients on NIV.

DISCUSSION

There was a predominance of male patients in this study (M:F=1.4). The gender distribution was close to other studies like: Kansal H et al., (M:F=1.38); Sharma S et al., (M:F=1.09) and Ibrahim B and Jaber D (M:F=1.32) [6-8]. Most of the cases belonged to the age group of 40-60 years; mean age being 56.5 years with SD=11.6 years. Mean age in few other studies were as follows: Kansal H et al., (54.65 years); Sharma S et al., (48 years) and

Ibrahim B and Jaber D (59.6 years) [6-8]. Co-morbidities were present in 46.67% (28 patients); where hypertension (25%) and DM (diabetes mellitus) 20%; were most common. These co-morbidities played a definite unfavourable role in the outcome of NIV. Here, 51.72% patients with co-morbidities were unsuccessful with NIV. Considering the individual co-morbidities like DM have influenced an increase in NIV failure. Another Author, Correa TD et al., also reported an increased NIV failure in the presence of co-morbidities [9]. The common symptoms were: Shortness of Breath (SOB) (100%), cough (95%) and fever (41.67%). A study by Kansal H et al., also found SOB (82%) and fever (52%) as common symptoms of RF [6].

The frequency of Type 1 and Type 2 RF in this study showed a clear predominance of Type 2 (63.33%, n=38) over Type 1 RF (36.67%, n=22). Two other Indian studies reported the following frequencies respectively: Type 2 RF (58.69%), Type 1 RF (41.34%); and Type 2 RF (56.98%), Type 1 RF (43.01%) [7,10]. The values of both the studies were comparable to the results of this study. On the other hand, an Egyptian study by Ibrahim B and Jaber D found Type 2 RF (26.92%) frequency to be much less than Type 1 RF (73.07%). In the present study AECOPD (52%) was the leading cause of Type 2 RF needing NIV; leaving asthma exacerbation (03%) far behind. In Type 1 RF, pneumonia (18%) surpassed other causes like ILD (13%) [8]. The study by Sharma S et al., has also found AECOPD as the common cause of Type 2 RF and ALI/ ARDS for Type 1 RF [7]. Another study by Abraham G et al., has reported AECOPD and pneumonia as the commonest causes of Type 2 and Type 1 RF, respectively [11].

Significant improvement of HR and RR from baseline was noted after 1 and 4 hours of NIV initiation, in both hypoxaemic and hypercapnic RF. But values improved to a greater extent in hypoxaemic patients. This was also reflected in blood gas parameters. The initial assessment of severity by APACHE II score and PaO_2/FiO_2 ratio gives a good insight into the prediction of outcome.

Overall, NIV failure rate in the study was 48.33%; more failures were found in Type 1 RF (63.63%) while failure rate was much less in Type 2 RF (39.47%). Melo FES et al., has reported that the overall failure rate of NIV was 51.4% [12]. NIV failure rate of few other studies and their comparisons were shown in [Table/Fig-8] [7-8,13]. The NIV failure rates in RF of COPD have ranged from 5% to 40% in different studies [5]. The higher failure rate (48.38%) in this present study was possibly due to delay in admission owing to limited RCU beds and overcrowding of tertiary care hospitals.

Although NIV decreases inspiratory muscle effort, increases the tidal volume and oxygenation status in patients of ALI/ARDS, yet evidences do not support routine use of NIV in hypoxaemic RF. In a study by Agarwal R et al., it has been found that intubation rate varied from 30-80% in NIV failure in ALI/ARDS cases [14].

A study conducted by Agarwal R et al., in Chandigarh, India on effectivity of NIV on Type 1 RF, reported that 12 out of 21 patients with ALI/ARDS had failed with NIV, i.e., the failure rate was 57.1% [10]. There was a significant failure rate in Type 1 RF with NIV. Patients of ALI/ARDS have shown the worst while pneumonia patients had comparatively better outcomes; NIV used for post-extubation pressure support in cases with exacerbation of asthma has shown 100% success. However, this finding may be influenced by the small number of cases in these two indications vide [Table/Fig-6]. The NIV failure rate in Type 2 RF in this study was close to another Indian study by Sharma S et al., [7]. The present study found four main indicators of failure of NIV: i) non-improvement of ABG parameters (37.93%); ii) inability to improve dyspnoea (24.14%); iii) haemodynamic instability (20.7%); and iv) deteriorating level of consciousness (17.25%). Study by Ibrahim B and Jaber D reported haemodynamic instability (8.33%) as the prime reason for discontinuation of NIV [8]. Persistent dyspnoea, non-improvement of ABG and excessive secretion were the other reasons. Correa TD et al., has found worsening hypoxaemia (65.4%) the commonest and haemodynamic instability (3.8%) and neurological downfall (19.2%) the other reasons for NIV discontinuation [9].

Unfavourable outcome with NIV would lead to intubation and mechanical ventilation or case fatality. The present study revealed that the mean-time for intubation after NIV initiation in such cases was 5.78 hours in Type 1 RF and 8.03 hours in Type 2 RF. Sharma S et al., reported 5.5 hours in Type 1 RF and 8.0 hours in Type 2 RF [7]. Case fatality in this study was 31.66%, i.e., 19 out of 60 patients. Type 1 RF case fatality was more, 45.45% (10 out of 22 patients); while in Type 2 RF, fatality was 23.68% (9 out of 38 patients). Study by Sharma S et al., has reported 42.1% in Type 1 RF and 25.9% in Type 2 RF; these appear close to our figures [7].

Favourable outcome leading to successful discharge was achieved for 41 patients (68.33%); average duration of hospital stay was 15.01 days. The corresponding figures reported by Sharma S et al., were 68.4% for discharge and 13 days of total hospital stay [7].

Limitation(s)

There was relatively small number of cases. This small data input, sometimes, can limit the assessment of possible factors of success or failure as contributory or as confounding. Moreover from aetiological view point, small number of some disease entity has apparently increased/decreased the result in terms of absolute number.

Name of the study/Authors	Year	Place	NIV failure rate			Disease specific NIV failure rate			
			Overall	Type 2 RF	Type 1 RF	AECOPD	Pneumonia	ALI/ ARDS	ILD
Present study	2017	Eastern India	48.33%	39.47%	63.63%	48.38%	45.45%	100%	75%
Sharma S et al., [7]	2012	North India	53.5%	42.37%	66.67%	41.2%	63.6%	75%	88.9%
Ibrahim B and Jaber D [8]	2014	Egypt	33%	28.57%	21.05%	25%	52.8%	-	-
Correa TD et al., [9]	2015	Brazil	30.6%	25%	33.3%	-	-	-	-
Biswas D et al., [13]	2018	Eastern India	10.53%	-	-	10.53%	-	-	-

[Table/Fig-8]: Comparison of NIV failure rate in different studies [7-8,13].

CONCLUSION(S)

Non-Invasive Ventilation was found to be a useful modality in the management of hypercapnic RF. Although NIV was also useful in hypoxaemic failure, but it should be used in a judicious manner. Chances of NIV failure was more in hypoxaemic RF. Non-improvement of ABG parameters in 1st and 4th hour of NIV initiation, worsening of ABG parameters, development of haemodynamic instability, deteriorating level of consciousness, disease severity at admission (APACHE II score), all play pivotal roles in the outcome assessment. Importantly, there are very few studies on NIV practices in RCU from India, specially from Eastern India. Therefore, the proper utilisation of NIV is lacking here. This study may strengthen the fact that efficient utilisation of NIV therapy in properly selected patients of ARF can lead to significantly reduced need for endotracheal intubation and IMV and thus reduce the cost and complications.

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