

# Comparison of Invasive vs Noninvasive mechanical Ventilation in Acute Exacerbation of COPD Patient for Ease of Ventilation Weaning & Outcome.

Sidharth Sraban Routray<sup>1</sup>, Deba Prasad Mohanty<sup>2</sup>, Debasis Mishra<sup>3</sup>, Ambika Prasad Panda<sup>3</sup>

<sup>1</sup>Assistant professor, Department of Anaesthesiology and critical care, SCB Medical College & Hospital, Cuttack, Odisha, India

<sup>2</sup>Associate Professor, Department of Anaesthesiology and critical care, SCB Medical College & Hospital, Cuttack, Odisha, India

<sup>3</sup>Senior Resident, Department of Anaesthesiology and critical care, SCB Medical College & Hospital, Cuttack, Odisha, India

## ABSTRACT

**Background:** Acute exacerbation of the COPD can cause respiratory failure which requires ICU and mechanical ventilation. But invasive mode of ventilation associated with various complications, weaning failure, lengthy hospital stay and more mortality and morbidity. So our aim in the study was to compare it with the noninvasive mode and their outcome.

**Methods:** A prospective randomized non blind study was undertaken in 104 patients of either sex, age group 35 to 65 with acute exacerbation of COPD. Patients were randomized in to either group odd or even number basis, one group received Non Invasive Ventilation (NIV) and other group received Invasive Mechanical Ventilation (IMV). Ease of ventilation was studied by serial estimation of tidal volume (TV), respiratory rate (RR), pressure support needed (PC above PEEP), PaCO<sub>2</sub>, Ph at 0, 4th, 12th, 24th, 48th hr of Mechanical ventilation and at the beginning of weaning. Ease of weaning was studied in terms of time needed for weaning, Number of weaning trials attempted, Percentage of weaning failure, Complications faced. **Results:** The mean tidal volume requirement was more in NIV group when compared to IMV group. Mean of Respiratory rate at the time of admission in NIV group was high, and there was gradual reduction in respiratory rate over time. At the time of admission mean PaCO<sub>2</sub>, PaO<sub>2</sub>, Ph were not statistically significant in both the groups but with time the improvement in PaCO<sub>2</sub> was better in IMV group when compared to NIV group (p value < 0.001) and the correction of ph was rapid in IMV group when compared with NIV group. (p value < 0.001). Patients on IMV needed more time for weaning when compared to NIV group. More number of weaning attempts were required in IMV group. **Conclusion:** IMV was a better mode for maintenance and NIV was better for weaning and overall outcome of ventilation of COPD patient. So NIV may be preferred as mode of choice unless there is chance of complication due to it.

**Keywords:** COPD, invasive, noninvasive.

## INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a lung disease characterized by chronic obstruction of lung airflow that interferes with normal breathing and is not fully reversible. It is a leading cause of morbidity and mortality in countries of high, middle, and low income. Estimates from WHO's Global Burden of Disease and Risk Factors project show that in 2014, COPD was the fifth leading cause of death in high-income countries and the sixth leading cause of death in nations of low and middle income, accounting for 4.9% of total deaths. Crude estimates suggest there are 30 million COPD patients in India.<sup>[1]</sup> India contributes a significant and growing percentage of COPD mortality which is estimated to be amongst the highest in the world (>20%).

and mechanical ventilation for those with acute exacerbation of COPD or rapidly deteriorating.

Acute exacerbation of the COPD can cause respiratory failure, which requires ICU admission and mechanical invasive ventilation. Mechanical invasive ventilation has its limitations because of complications like infection and also difficulty in weaning the patient. This causes increase in the morbidity and mortality rate. Non-invasive ventilation is a recently developed tool in managing respiratory failure due to acute exacerbation of COPD and has shown to have good outcomes in terms of reduction in mortality, reduction in need for intubation and mechanical ventilation and decreased duration of stay in the hospital.

This study was conducted to compare the ease of ventilation, weaning, and outcome by using non-invasive and invasive ventilation in acute exacerbation of COPD patients.

### Name & Address of Corresponding Author

Dr Sidharth Sraban Routray  
Assistant professor,  
Dept of Anaesthesiology and critical care,  
SCB Medical College & Hospital,  
Cuttack, Odisha, India.  
E mail: drkitusraban@gmail.com

## MATERIALS AND METHODS

A prospective randomised non blind study was undertaken in 104 patients of either sex, age group 35 to 65 with acute exacerbation of COPD of moderate to severe degree on clinical and % predicted PEFR measurement basis, over a period from march 2013 to march 2014 admitted to CICU and MICU, SCB Medical College, Cuttack.

Informed consent from patients and the attendants were taken and written permission from hospital

There is no known cure for COPD, but the symptoms are treatable and its progression can be delayed by pulmonary rehabilitation, bronchodilators (b<sub>2</sub> agonists, anticholinergics), corticosteroids, antibiotics for those with purulent sputum, oxygen

ethical committee, i/c CICU, i/c MICU SCB Medical College and Hospital cuttack were also taken..

On admission, each patient was thoroughly evaluated and the following patient data were collected: sex, age, weight, comorbidities. Severity of illness was assessed using Acute Physiology and Chronic Health Evaluation (APACHE II) score on admission.

Patients were randomized in to either group odd or even number basis, one group received Non Invasive Ventilation (NIV) and other group received Invasive Mechanical Ventilation (IMV). Pressure Control (PC mode) mode was used for maintenance and Pressure support (PS mode) mode was used for weaning of the Patients on IMV group. Similarly, NIV (PC) mode was used for maintenance and NIV (PS) mode was used for weaning of the Patients on NIV group. Ease of ventilation was studied by serial estimation of tidal volume (TV), respiratory rate (RR), pressure support needed (PC above PEEP), PaCO<sub>2</sub>, Ph at 0, 4th, 12th, 24th, 48th of Mechanical ventilation and at the beginning of weaning .Ease of weaning was studied in terms of time needed for weaning, Number of weaning trials attempted, Percentage of weaning failure, Complications faced.

Patients of age <35 yrs&>65 yrs, with history of liver, heart & kidney diseases, those who were transferred from one to other group, Unconscious, with history of chronic alcoholism and Neuromuscular diseases were excluded from study During ICU stay, patients received all necessary treatment required by their condition. All laboratory and clinical parameters were evaluated and corrected if necessary. All complications relating to invasive and non invasive ventilation were noted. Enteral nutrition was preferred to parenteral whenever possible, applied through nasogastric tube or per-orally.

In all patients included in the research, MV was administered by use of SERVO i MAQUET

ventilator system. (Universal version 6.0), face masks were applied for NIV (RESMED).

### Statistical Analysis

Independent sample & unpaired t-tests, chi-square tests, mean and standard deviation calculations and percentage calculations were done as required. Calculations were performed by a certified statistician using the software SPSS for Windows version 21.0. The P-values obtained were interpreted as follows:

- >0.05 : Not significant
- <0.05 : Significant
- <0.001 : Highly significant

## RESULTS

In this study 104 patients of either sex, age group 35 to 65 with acute exacerbation of COPD of moderate to severe degree on clinical and % predicted PEFR measurement basis were prospectively studied and as per exclusion criteria 44 patients were excluded (32 patients died, 6 patients cor pulmonale detected, 6 patients transferred from NIV to IMV). Remaining 60 patients were divided in to two groups IMV and NIV on even and odd basis [Table 1 & 2].

**Table 1:** Demographic data

	IMV	NIV	P-VALUE
<b>Age In Years</b>	53.53±6.25	52.5±8.8191	0.823
<b>Weight In Kgs</b>	58.10 ± 4.60	58.2±4.57	0.9330
<b>Sex</b>	19/11	21/9	0.58

**Table 2:** Baseline values

	IMV	NIV	P VALUE
<b>Apachi II Score</b>	17.33 ± 2.35	17.33 ± 2.35	1
<b>PaCO<sub>2</sub></b>	115.7± 2.91	114.8 ± 4.38	0.672
<b>SPO<sub>2</sub></b>	90.7± 2.45	90.53± 2.96	0.5434
<b>Pao<sub>2</sub></b>	60.43 ± 4.462	65.2 ± 8.98	0.0823

**Table 3:** Ease of ventilation

	VT		RR		PS		P-Value
	IMV	NIV	IMV	NIV	IMV	NIV	
<b>AT ADMISSION</b>	325.93	481.83	14.33	23.03	12.17	17.53	P < 0.001
<b>AT 4 HRS</b>	347.3	491.67	13.93	20.2	11.6	16.23	P < 0.001
<b>AT 12 HRS</b>	357.67	523.67	14.37	16.27	11.07	15.27	P < 0.001
<b>AT 24 HRS</b>	387.1	540.33	13.87	16	11.07	15.23	P < 0.001
<b>AT 48HRS</b>	405.07	542.67	12.77	15.9	9.67	14	P < 0.001
<b>WEANING</b>	427.1	582	12.23	14.77	8.03	10.1	P < 0.001

The mean tidal volume requirement was more in NIV group when compared to IMV group. Mean of Respiratory rate at the time of admission in NIV group was 23.03, and there was gradual reduction in respiratory rate over time, at 48 hrs it was 15.9 and at weaning it was 14.77(p value <0.001) but in IMV group at admission the mean of respiratory rate in IMV group was 14.33 and at weaning mean respiratory rate was 12.23(p value < 0.001).

At admission the mean of pressure support required for NIV was 17.53 cm of H<sub>2</sub>O, when compared to IMV it was 12.17 cm of H<sub>2</sub>O ( p value < 0.001) throughout the ICU stay the mean of pressure support requirement was more for patients in NIV group. At weaning mean pressure requirement in NIV group was 10.1 cm of H<sub>2</sub>O but in IMV group, it was 8.03 cm of H<sub>2</sub>O [Table 3]. Ease of ventilation when compared on the basis of tidal volume (VT), respiratory rate (RR) and pressure support (PS) p

value was found to be highly significant (p value < 0.001).

**Table 4:** PH, PaCO<sub>2</sub> Trend

	PaCO <sub>2</sub>			pH		
	IMV	NIV	p-Value	IMV	NIV	p-Value
<b>At Admission</b>	115.7	114.8	0.35	7.26 ± 0.03	7.26 ± 0.03	1
<b>At 4 Hrs.</b>	90.73	104.43	p < 0.001	7.30 ± 0.03	7.25 ± 0.02	p < 0.001
<b>At 12 Hrs.</b>	81.8	95.13	p < 0.001	7.34 ± 0.03	7.31 ± 0.02	p < 0.001
<b>At 24 Hrs.</b>	71.2	84.7	p < 0.001	7.35 ± 0.02	7.32 ± 0.01	p < 0.001
<b>At 48 Hrs.</b>	64.1	80.1	p < 0.001	7.36 ± 0.02	7.33 ± 0.01	p < 0.001
<b>At Weaning</b>	54.73	60.07	p < 0.001	7.38 ± 0.03	7.33 ± 0.01	p < 0.001

**Table 5:** Pao<sub>2</sub> trend

	IMV	NIV
<b>At Admission</b>	60.43	65.2
<b>At 4 Hrs.</b>	79.97	82.77
<b>At 12 Hrs.</b>	94.77	99.17
<b>At 24 Hrs.</b>	102.33	107.13
<b>At 48 Hrs.</b>	108.87	110.9
<b>At Weaning</b>	108.5	110.9

**Table 6:** Ease of weaning

PARAMETERS	IMV	NIV	p-VALUE
<b>Time needed (Days)</b>	4 ± 0.76	2 ± 0.66	P < 0.001
<b>No. of Trials</b>	2 ± 0.67	1 ± 0.35	P < 0.001
<b>Weaning Failure</b>	34%	6.8%	P < 0.001
<b>Complications</b>	26.67%	6.67%	0.038
<b>Days in ICU</b>	7	5	

At the time of admission mean PaCO<sub>2</sub>, PaO<sub>2</sub>, Ph were not statistically significant in both the groups but with time the improvement in PaCO<sub>2</sub> was better in IMV group when compared to NIV group (p value < 0.001) and the correction of ph was rapid in IMV group when compared with NIV group. (p value < 0.001) [Table 4]. Patients on IMV needed more time for weaning when compared to NIV group. More number of weaning attempts were required in IMV group.

In IMV group out of 30 patients 8 patients (26%) had complications but in NIV group, only 2 patients (6%) showed complications [Table 6]. Duration of stay in ICU in IMV group was 7 days, which was more than NIV group i.e 5 days [Table 6].

## DISCUSSION

COPD is one of several chronic diseases that are becoming increasingly problematic worldwide. Their increasing burden and monetary cost are a particular risk to low- and middle-income countries. COPD is predicted to become the third leading cause of death worldwide by 2030.

### Age and sex prevalence

In our study the mean age in IMV group was 53.53yrs ± 6.25 & the mean age in NIV group was 52.5yrs ± 8.8191, Out of 30 patients in IMV group, 19 ( 63.3% ) were male & 11 ( 36.7% ) female & in NIV group 21 ( 70% ) were male & 9 ( 30% ) were female. In our study, the incidence of COPD increases with increasing age and it is more common

in males when compared with females. This is consistent with studies like Jindal S K et al<sup>[2]</sup> and Medui et al<sup>[3]</sup>. In our study mean APACHE II score in both the groups at the time of admission was 17.33. Vitacca M et al<sup>[4]</sup> in their research report said that patients with COPD who had high APACHE II score, also had high NIV failure rate.

### Ease of ventilation

In our study the ease of ventilation in both the groups were compared on the basis of ventilator parameters (respiratory rate, tidal volume, pressure support required) and pulmonary biochemistry parameters (ph, PaCO<sub>2</sub>).

### Ventilatory parameters

In our study the mean tidal volume requirement was more in NIV group than IMV group i.e at admission in IMV group it was 325.93 ml in NIV group it was 481.83 ml, at weaning the tidal volume requirement in NIV group was 582 ml and in IMV group it was 427.1 ml with (p value < 0.001). In contrast, Ivo Matic et al<sup>[5]</sup> showed the tidal volume requirement 1 hour after admission in IMV group was 500ml and in NIV group was 330 ml (p value < 0.001 ) and at 48 hrs tidal volume requirement in NIV group was 400 ml and in IMV group was 540 ml ( p value < 0.001 ), in this study the tidal volume requirement for IMV group was more than NIV group.

In present study, the mean of Respiratory rate at the time of admission in NIV group was 23.03/min, and there was gradual reduction in respiratory rate over time, at 48 hrs it was 15.9/min and at weaning it was 14.77/ min. but in IMV group the variation in

respiratory rate was less, at admission the mean of respiratory rate in IMV group was 14.33/ min and at weaning mean respiratory rate was 12.23/ min (p value < 0.001). Similar results were found in studies by Ivo Matic et al<sup>[5]</sup>.

In this study, at admission the mean of pressure support required for NIV was 17.53 cm of H<sub>2</sub>O, when compared to IMV it was 12.17 cm of H<sub>2</sub>O. The mean of pressure support requirement was more for patients in NIV group. At weaning mean pressure requirement in NIV group was 10.1 cm of H<sub>2</sub>O but in IMV group it was 8.03 cm of H<sub>2</sub>O, with p value < 0.001. No studies are there, where there is comparison of pressure support between both the groups.

#### **Pulmonary biochemistry parameters**

At the time of admission mean PaCO<sub>2</sub> in IMV group was 115.7 mm of Hg and in NIV group was 114.8 mm of Hg which was statistically not significant (p value= 0.35), with time the improvement in PaCO<sub>2</sub> was better in IMV group when compared to NIV group ( p value was < 0.001) i.e highly significant. In other studies like IvoMatic et al<sup>[5]</sup>, Phua J et al<sup>[6]</sup> and Tsai et al<sup>[7]</sup>, NIV was better in terms of improvement in PaCO<sub>2</sub>.

Mean ph at the time of admission in both the groups are similar i.e 7.26±0.03 (p value 1) the correction of ph was rapid in IMV group when compared with NIV group. At weaning the mean ph was 7.38±0.03 in IMV group, in NIV group it was 7.33 ± 0.01. (p value <0.001). Brochard et al<sup>[8]</sup> in a multicentric study, conducted on 85 COPD patients reported rapid improvement in PaO<sub>2</sub>, and slower correction of PaCO<sub>2</sub>. Even so, they conclude that NIV is not a good choice for patients with COPD because only 29% of patients in their study were suitable for successful NIV. They recommend that NIV can only be considered as an alternative procedure to IMV. In other studies like Ivo Matic et al<sup>[5]</sup>, Phua J et al<sup>[6]</sup> and Tsai et al<sup>[7]</sup> NIV was better in terms of improvement in ph.

#### **Ease of weaning**

In our study ease of weaning in both IMV and NIV group were compared on the basis of time needed for weaning (in days), no of trials attempted, weaning failure and complications encountered. Time needed for weaning in IMV group was 4 days ±0.76 when compared to NIV group it was 2 days± 0.66. Patients on mechanical ventilator needed more time for weaning when compared to NIV group. In IMV group out of 30 patients 8 patients (26%) had complications but in NIV group only 2 patients (6%) showed complications.

According to study by Ivo Matic et al<sup>[5]</sup>, NIV had proven superiority than IMV in terms duration of total ICU length of stay and the need for tracheostomy in facilitating the weaning process. Furthermore, hospital pneumonia was recorded in

only 2 patients in NIV group compared to 12 in the IMV group. But no statistical difference in mortality rates was recorded between groups. This was possibly due to relatively small sample size but also because most severe patients have similar mortality rates. Keenan et al<sup>[9]</sup> in their study confirmed the superiority of NIV over IMV in patients with acute exacerbation of COPD, reduces the need for endotracheal intubation, lowers mortality rate from 15% to 10% and reduces duration on ventilator from 6.83 to 4.57 days.

Brochard et al<sup>[8]</sup> in a multicentric study showed patients randomized for NIV had significantly lower intubation rates, less complications (14%:45%, p <0.001) and reduced mortality (9%:29%, p=0.02), as well as shorter hospital treatment duration (23±17:35±33 days, p =0.02).

Most recently Ferrer et al<sup>[10]</sup> randomized 43 patients who had failed 3 consecutive T-piece SBTs to either NIV (minimum of 24 h) or conventional weaning. NIV weaning was associated with shorter duration of invasive ventilation (9.5 vs 20.1 d), shorter ICU stay (14 vs 25 d), shorter hospital stay (28 vs 49 d), fewer tracheotomies (5 vs 59%), better ICU survival (90 vs 59%), fewer re-intubations (14 vs 27%), and a lower incidence of nosocomial pneumonia and septic shock. Similar result also had shown by Girault et al<sup>[11]</sup>.

## **CONCLUSION**

Study was undertaken with well defined ventilation protocols and comparison based on the objective parameters of pulmonary mechanics, biochemistry and treatment outcome. It showed a male preponderance of COPD in our study and incidence increases with increase in age. IMV was a better mode for maintenance and NIV was better for weaning and overall outcome of ventilation of COPD patient. So NIV may be preferred as mode of choice unless there is chance of complication due to it.

## **REFERENCES**

1. Global initiative for Chronic Obstructive Lung Disease, Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease NHLBI/WHO workshop report. National Institutes of Health, National Heart, Lung, and Blood Institute. 2013; 2014. Report No.: 2701.
2. Jindal SK1, Aggarwal AN, Chaudhry K, Chhabra SK, D'Souza GA, Gupta D, Katiyar SK, Kumar R, Shah B, Vijayan VK. Asthma Epidemiology Study Group. Indian J Chest Dis Allied Sci. 2006 Jan-Mar; 48(1):23-9
3. Meduri GU, Turner RE, Abou-Shala N, Wunderink R, Tolley E. Noninvasive positive pressure ventilation via face mask: first-line intervention in patients with acute hypercapnic and hypoxemic respiratory failure. Chest. 1996;109(1):179-193
4. Vitacca M, Ambrosino N, Clini E, Porta R, Rampulla C, Lanini B, Nava S. Physiological response to pressure support ventilation delivered before and after extubation in patients not

- capable of totally spontaneous autonomous breathing. *Am J Respir Crit Care Med.* 2001;164(4):638–641
5. Matic I, Majeric-Kogler V, Sakic-Zdravcevic K, Jurjevic M, Mirkovic I, Hrgovic Z. Comparison of Invasive and Noninvasive Mechanical Ventilation for Patients with COPD: Randomised Prospective Study. *Indian J Anaesth.* 2008; 52:419
  6. Phua J, Kong K, Lee KH, Shen L, Lim TK. *Intensive Care Med.* 2005 Apr; 31(4):533-9.
  7. Tsai CL, Lee WY, Delclos GL, Hanania NA, Camargo CA Jr. *J Hosp Med.* 2013 Apr;8(4):165-72.
  8. Brochard L, Rauss A, Benito S, Conti G, Mancebo J, Rekik N, et al. Comparison of three methods of gradual withdrawal from ventilator support during weaning from mechanical ventilation. *Am J Respir Crit Care Med.* 1994;150(4):896–903.
  9. Keenan SP, Sinuff T, Cook DJ, Hill NS. Which patients with acute exacerbation of chronic obstructive pulmonary disease benefit from noninvasive positive-pressure ventilation? A systematic review of the literature. *Ann Intern Med.* 2003; 138(11):861–870
  10. Ferrer M, Esquinas A, Arancibia F, Bauer TT, Gonzalez G, Carrillo A, et al. Noninvasive ventilation during persistent weaning failure: a randomized controlled trial. *Am J Respir Crit Care Med.* 2003;168(1):70–76
  11. Girault C, Daudenthun I, Chevron V, Tamion F, Leroy J, Bonmarchand G. Noninvasive ventilation as a systematic extubation and weaning technique in acute-on-chronic respiratory failure: a prospective, randomized controlled study. *Am J Respir Crit Care Med.* 1999;160(1):86–92.

**How to cite this article:** Routray SS, Mohanty DP, Mishra D, Panda AP. Comparison of Invasive vs Noninvasive mechanical Ventilation in Acute Exacerbation of COPD Patient for Ease of Ventilation Weaning & Outcome. *Ann. Int. Med. Den. Res.* 2016;2(3):132-36.

**Source of Support:** Nil, **Conflict of Interest:** None declared