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Evaluating the Efficacy of Non-Invasive Mechanical Ventilation in Managing Acute Exacerbations of COPD in a Tertiary Care Centre Hapur Uttar Pradesh

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Abstract:-

- ***Background-***

COPD is currently ranked among the top 3rd leading leading cause of mortality globally, with ninety percent of the mortality concentrated in under developed and developing nations COPD poses a huge healthcare issue that is either preventable or treatable COPD is a bigger cause of long-term illness and mortality globally. Numerous patients endure this condition for extended periods and experience premature death as a result of the disease itself or its associated complications.

The implementation and extensive adoption of non-invasive mechanical ventilation (NIMV) have significantly transformed the management and survival outcomes for patients experiencing exacerbations of chronic obstructive pulmonary disease (COPD). This observational study aims to evaluate the outcomes of NIMV in AECOPD within our hospital setting.

- ***Objective:-***

To monitor and analyze the outcomes of patients managed with non- invasive mechanical ventilation, specifically focusing on the necessity for endo-tracheal intubation, mechanical ventilation, & improvements in A.B.G levels & vital signs.

- ***Material and Method:-***

This observational study was conducted on 100 patients with COPD. This study observed patients who underwent NIMV receiving pharmaceutical therapy for AECOPD. The evaluation of patients were depend upon clinical improvements, including reductions in respiratory rate and heart rate, as well as enhancements in arterial blood gas levels after initiating NIMV.

- ***Results:-***

The primary outcome assessed was the need for intubation. Among the 100 patients, 88 (88%) showed an improved outcome, including enhancements in pH, PaCO2, respiratory rate, and heart rate after the first and fourth hours of starting NIMV. The study found a statistically significant difference between these values, indicating the efficacy of NIMV in managing acute exacerbations of COPD

- ***Conclusion:-***

The study concludes that Non-Invasive Mechanical Ventilation (NIMV) shows promise as a treatment approach for managing acute exacerbations of Chronic Obstructive Pulmonary Disease (COPD). Timely implementation of NIMV results in rapid and significant change in arterial blood gas levels, thereby reducing the needed for endo-tracheal intubation in these patients.

Keywords:- *COPD; NIMV; AECOPD; Arterial Blood Gas*

I. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a diverse lung condition marked by chronic respiratory symptoms such as dyspnea, cough, sputum production, and exacerbations. It results from abnormalities in the airways (bronchitis, bronchiolitis) and/or the alveoli (emphysema), leading to persistent and often progressive airflow obstruction.[(1)]

Male gender and middle to old age are related with greater frequency of disease, perhaps due to increased rates of smoking among men. Instances of the sickness are infrequent before the age of 35 [(2)]

An acute exacerbation of COPD leads to worsening of respiratory symptoms, notably increased breathlessness and cough, & rise in sputum volume and/or a change in sputum color. [(3)]

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The first assessment of suspecting acute exacerbations of COPD requires a detailed clinical assessment, chest x ray, and necessary hematological investigation and phlegm testing. Arterial blood gas analysis is recommended to assess severity and establish a baseline for monitoring. [4]

Management of AECOPD aims to alleviate current symptoms and prevent future exacerbations. Pharmacologic treatment involves bronchodilators, corticosteroids, and antibiotics. [5]

Noninvasive mechanical ventilation provides ventilatory support without invasive artificial airways like endo-tracheal tubes or tracheostomy tubes. Its usage has significantly risen in recent decades, becoming essential in managing acute and chronic respiratory failure, either house and icu settings. [6]

Mostly patient of AE of COPD breathe via mouth, & full face mask are advised. Most beneficial to initially place the mask on the subjects for some time then attaching it with straps put on O_2 beginning flow rate (one-two liters per minute) & adjust it gradually to maintaining a SPO_2 of the range of 88 to 92%. Setting IPAP and EPAP, commonly beginning at 10 to 14 cm H_2O and 4 to 6 cm H_2O accordingly. The IPAP is then adjustable up to 15 to 20 cm H_2O as well as to highest pressured smoothly tolerating the patient. [7]

The primary outcome measures in randomized controlled trials that determine the effectiveness or ineffectiveness of NIMV are arterial blood gas parameters, particularly pH and $PaCO_2$, at one, four, and twelve hours . Additionally, the R.R at 1 hr & heart rate at 1 hr are also, considered a crucial markers..[8]

The implementation and extensive utilization of NIMV have improved the treatment and increased the chances of survival for patients experiencing an AECOPD. The success rate of NIMV regularly falls within the range of 76 to 85 percent, whereas, patients receiving standard medical care have a rate of success of between 40 and 50 percent. [9]

This observational study was performed to evaluate the outcomes of non-invasive mechanical ventilation in acute exacerbations of COPD within our hospital setting.

II. MATERIALS AND METHODS

100 adult patients of an acute exacerbation of chronic obstructive pulmonary disease were treated with NIMV after taking consent. This study observed patients who underwent NIMV receiving pharmaceutical therapy for AECOPD. The assessment of patients was depends on clinical condition , specifically a reducing in R.R, H.R, and improving in A.B.G levels after starting of NIMV.

An observation was made about a study of evaluating the efficacy of non-invasive mechanical ventilation in acute exacerbations of COPD within our hospital setting.

III. RESULT

Table1 Age Group

Age Group	Frequency	Percentage
41- 50 years	10	10.0
51 - 60 years	31	31.0
61 – 70 years	34	34.0
71 – 80 years	22	22.0
>80 years	03	03.0
Total	100	100.0
Min Age	63.32±9.36	

The average mean age was 63.32 years with a standard deviation of 9.31yrs

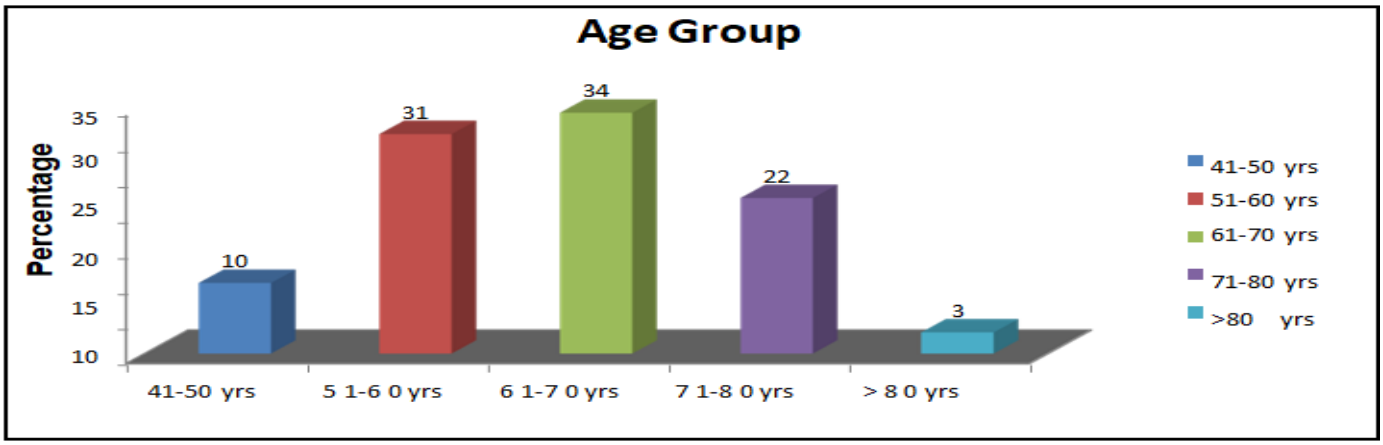

Fig 1 Graph Illustrating of an Age Group

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Table 2 Gender

Gender	Frequency	Percentage
Male	73	73.0
Female	27	27.0
Total	100	100.0

The majority of the subjects were male, making up 73% of the total, while females comprised only 27%.

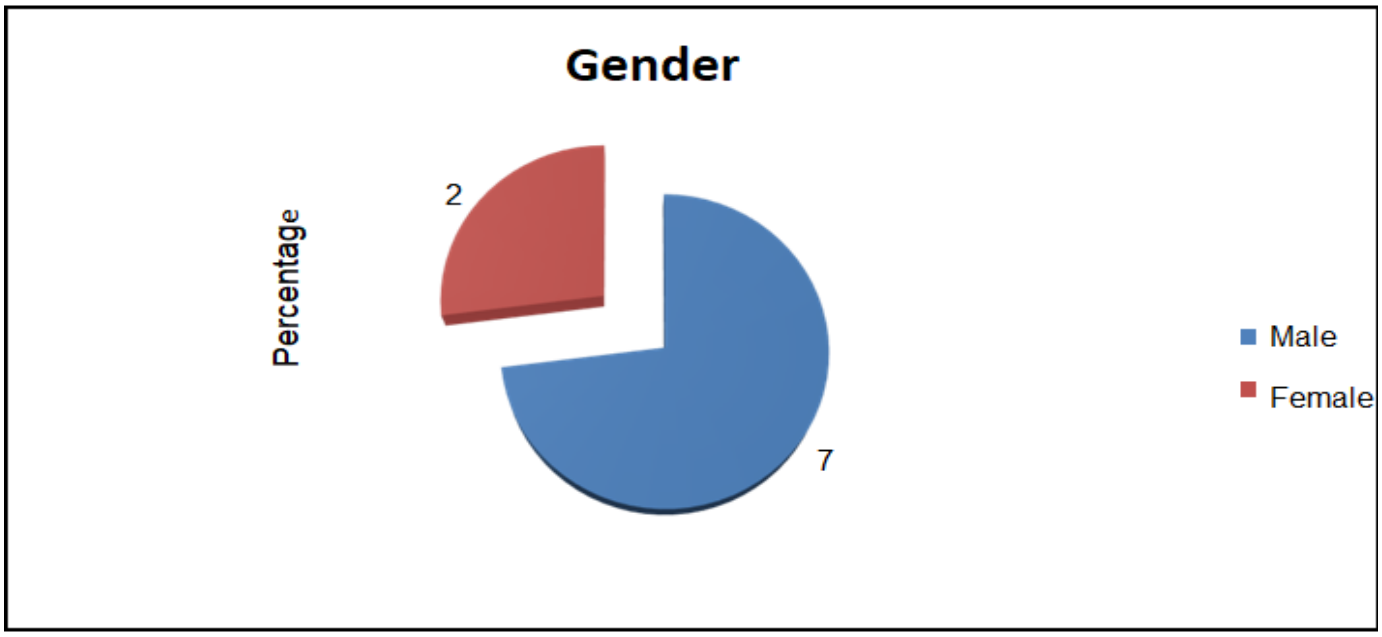

Fig 2 Graph Illustrating the Gender Distribution.

Table 3 Smoking History

Smoking history	Frequency	Percentage
Yes	80	80.0
No	20	20.0
Total	100	100.0

Most of the subjects, 80%, had a history of smoking, while 20% did not.

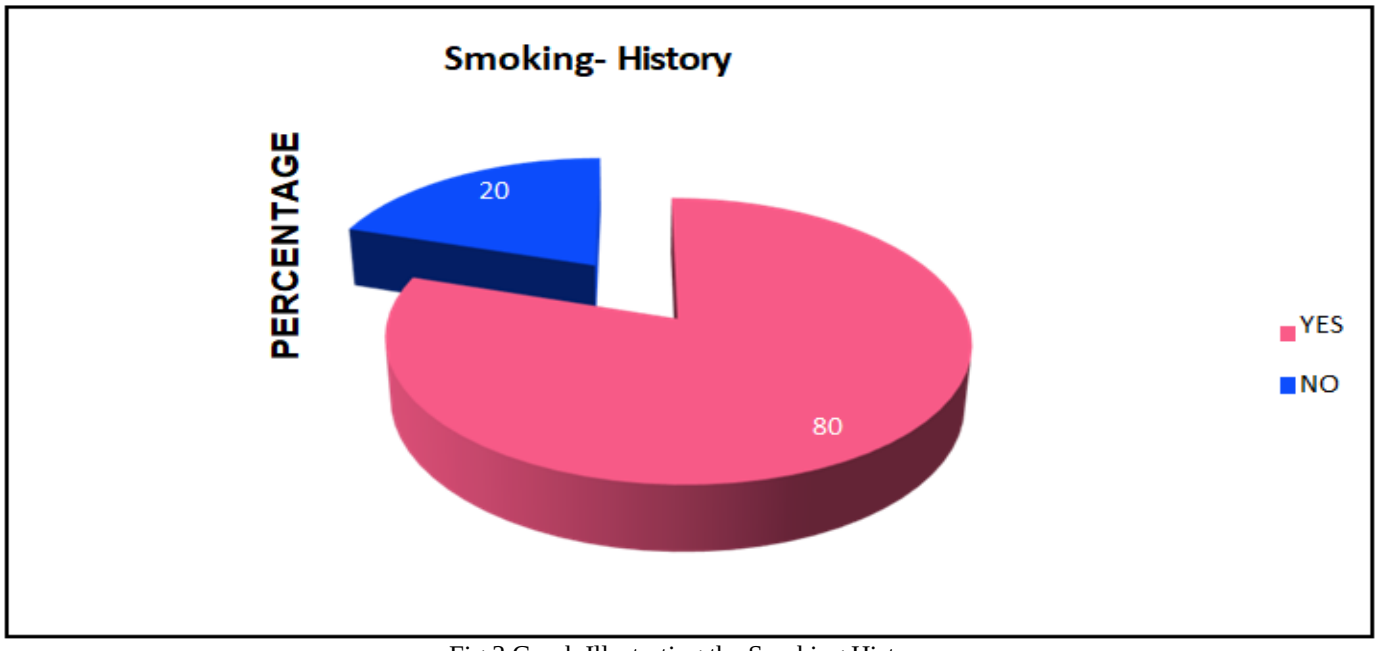

Fig 3 Graph Illustrating the Smoking History

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Table 4 Co-Morbidity

Co-Morbidity	Frequency	Percentage
None	14	17.5
Hypertension	66	82.5
Diabetes	24	30.0
IHD	06	7.5
Koch	07	8.8

Out of 100 patients, co-morbidities were analyzed, with 66 (82.5%) having hypertension, 24 (30%) having diabetes, 6 (7.5%) with a past history of ischemic heart disease (IHD), and 7 (8.8%) with a P/H of Koch 14 (17.5%) does not have co-morbid conditions.

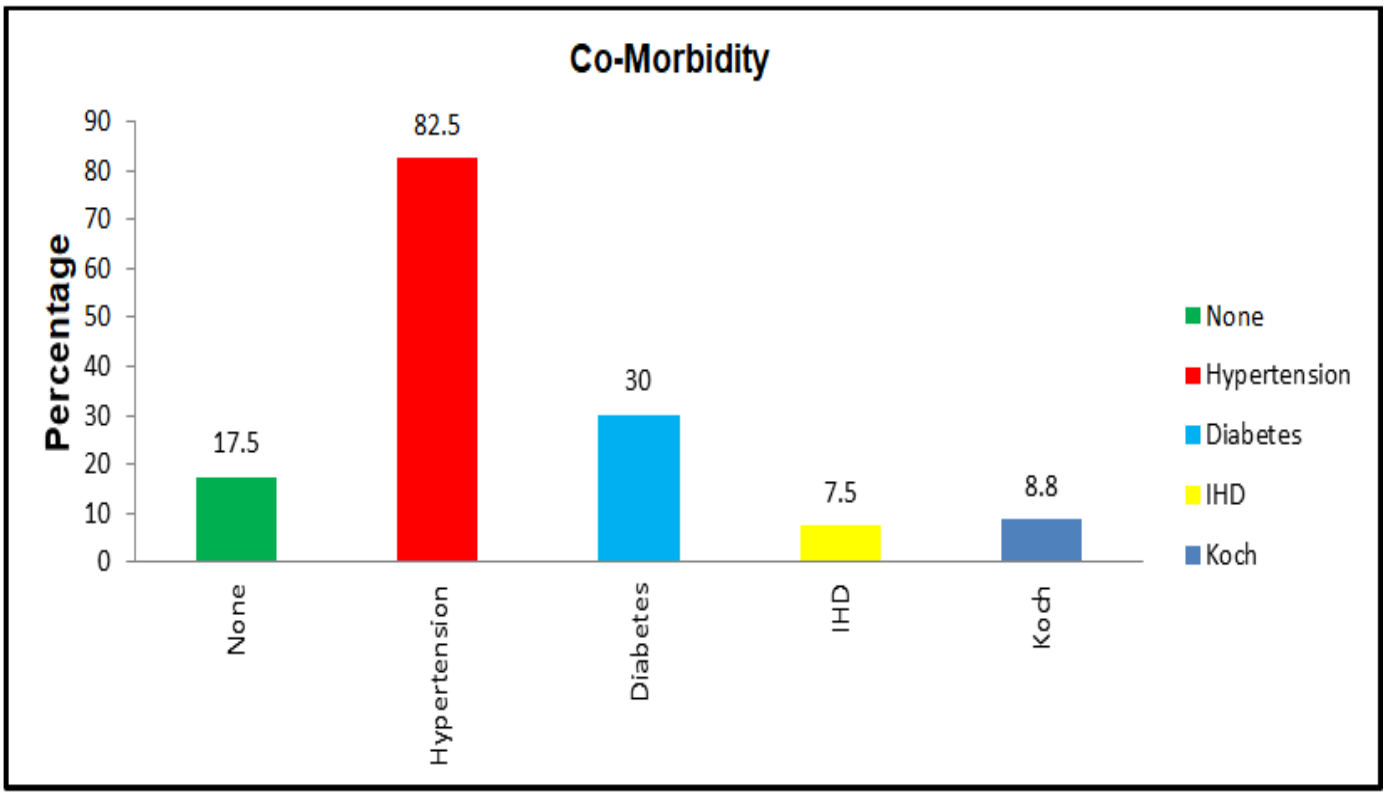

Fig 4 Graph Illustrating of Co- Morbidity

Table 5 Changes in Mean Heart Rate Level at Different Time Intervals

Intervals	Heart Rate (per minute)	
	Mean	±SD
Upon Admission	121.66	±09.47
1st Hour	111.37	±08.44
4th Hour	103.32	±10.73
Statistical Inference	**p-value for Admission and 1-hour:** < 0.00001 **Admission to 4 hour:** < 0.00001	

On admission, the Heart Rate was recorded in bpm , with Mean H.R of 121.66 and a standard deviation of 9.47. HR after first hr and fourth hrs of starting on NIMV. Mean H.R at the 1 hr decreased to 111.37 with a standard deviation of 8.44, showing statistical significance with a p-value of 0.00001. Similar, at the 4th hours, the mean heart rate was 103.32 with a standard deviation of 10.73, also demonstrating statistical significance with a p-value < 0.00001.

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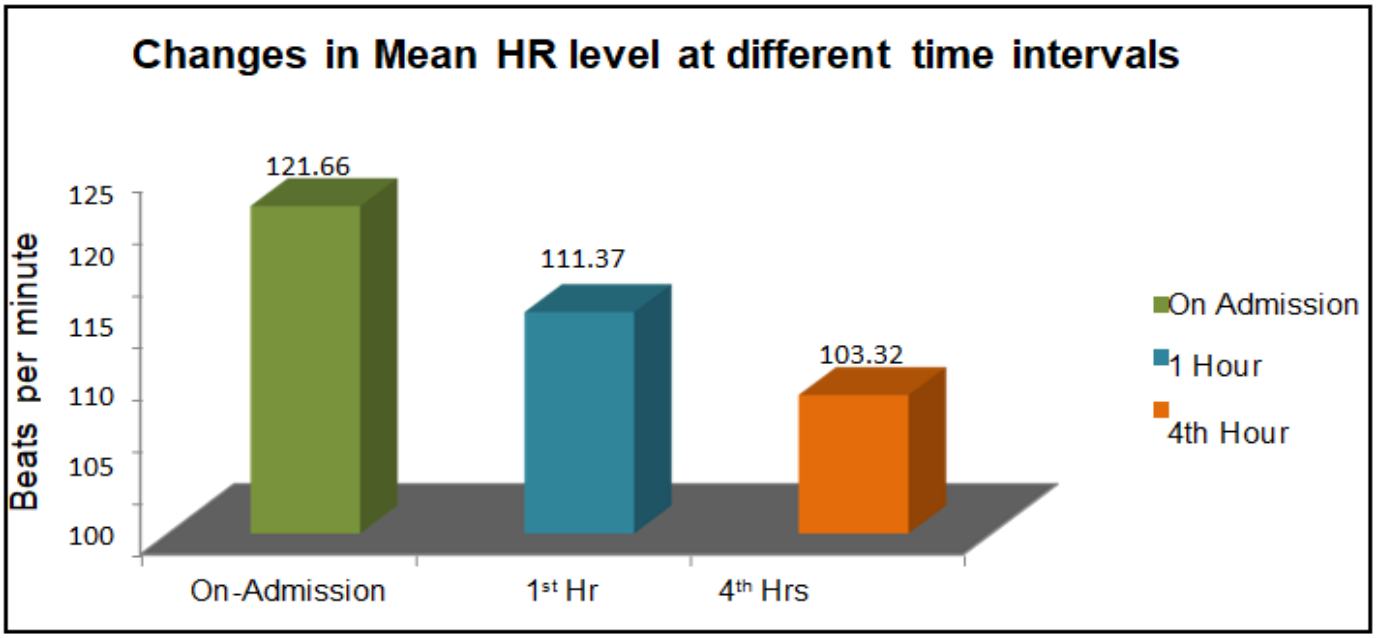

Fig 5 Graph Illustrating the Changes in Mean Heart Rate at Different Time Intervals

Table 6 Changes in Mean Rate of Respiration Level on Different Intervals

Intervals	Respiratory Rate (per minute)	
	Mean	±SD
Upon Admission	30.44	±02.25
1st Hour	26.26	±02.52
4th Hour	23.19	±04.40
Statistical Inference	**P - value for Admission and 1 - hour:** < 0.00001 **Admission to 4 hour:** < 0.00001	

Upon admission, the rate of respiration were measured in breath per minute, with a mean R.R of 30.44 and a standard deviation of 2.25. After 1 hour of initiating NIMV, the mean respiratory rate decreased to 26.26 with a S.D of 2.52, showing statistical significance with a p value of 0.00001, at the 4th hour, the mean respiratory rate was 23.19 with a S.D of 4.40, also demonstrating statistical significance with a p-value < 0.00001.

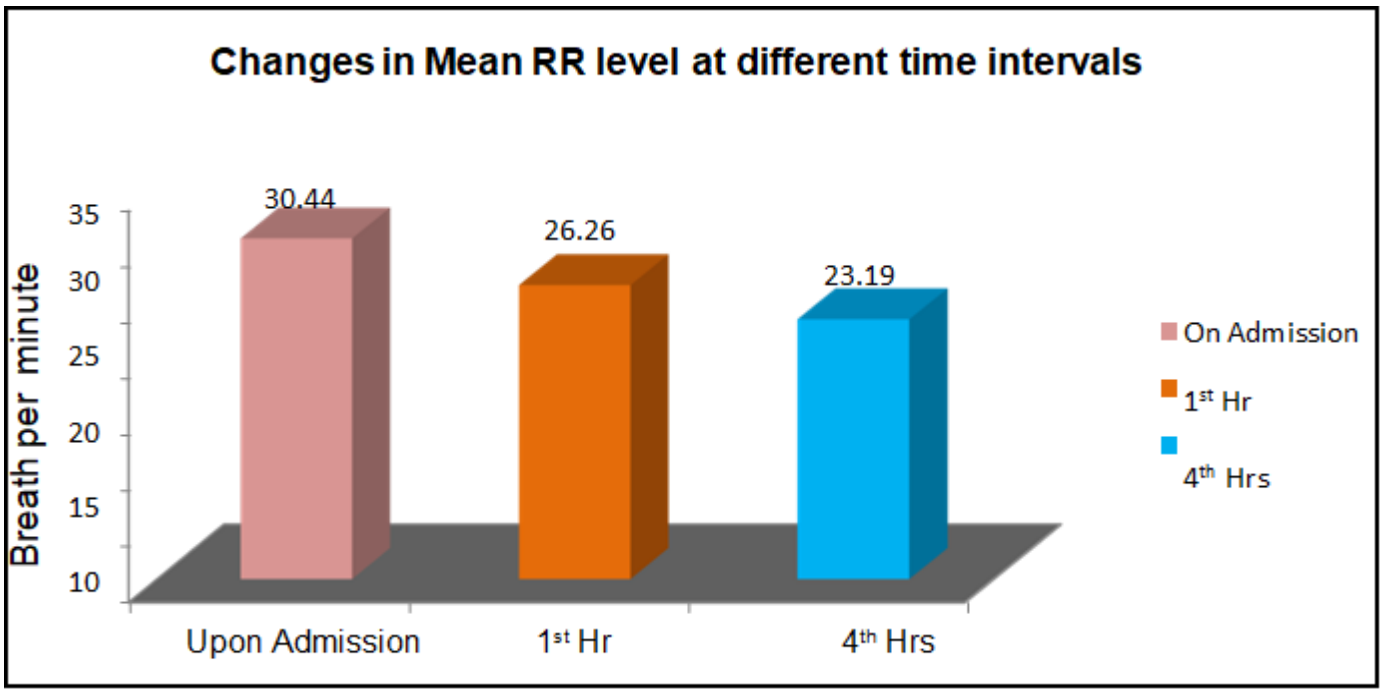

Fig 6 Graph Illustrating the Changes in Mean Respiratory Rate at Different Time Intervals

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Table 7 Changes in Mean Oxygen Saturation Level Different Intervals.

Intervals	pH	
	MEAN	±SD
Upon-Admission	79.27	±05.22
1st Hour	86.61	±03.73
4th Hour	89.20	±05.87
Statistical Inference	**P - value: Admission and 1 hour:** < 0.00001 **Admission to 4 hour:** 0.850	

Upon admission, the oxygen-saturation (SPO2) was measured. The mean SPO_2 was 79.27 with a standard deviation of 5.22. After 1 hour of initiating NIMV, the mean oxygen saturation increased to 86.61 with a S.D of 3.73, showing statistical significance with a p-value of 0.00001. Similarly, at the 4th hour, the mean oxygen saturation was 89.20 with a S.D of 5.87, also demonstrating statistical significance with a p-value <0.00001.

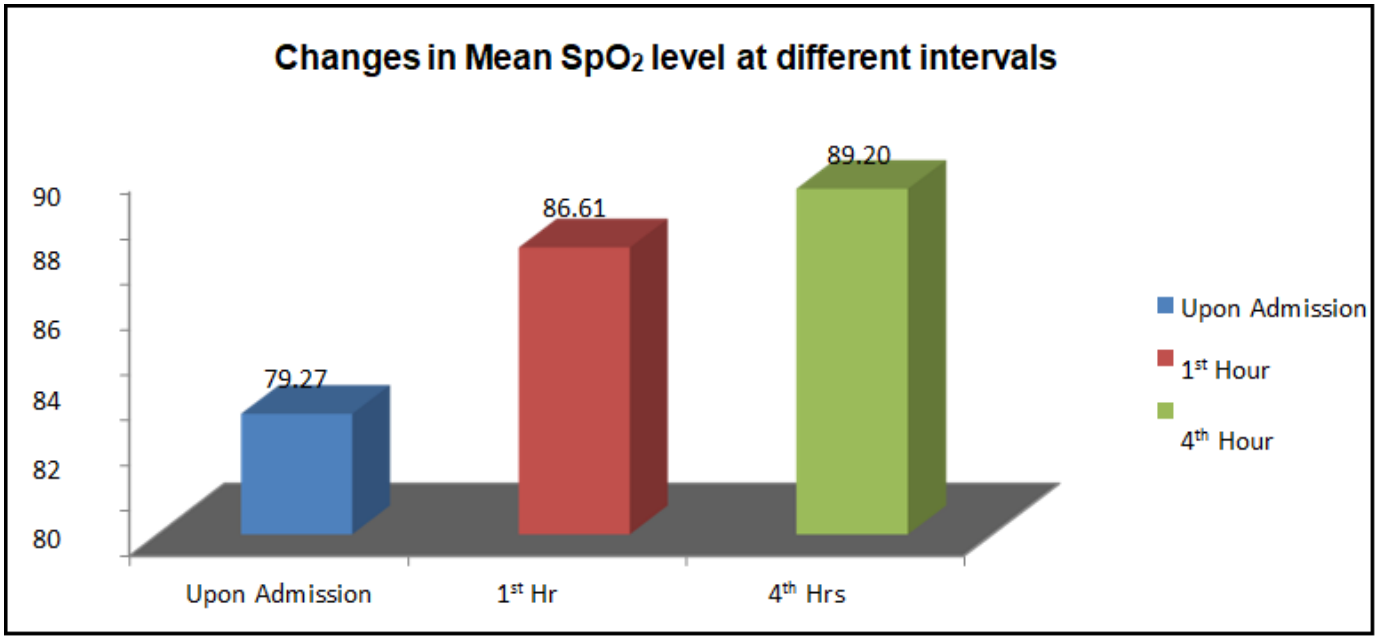

Fig 7 Graph Illustrating the Changes in Mean Oxygen Saturation at Different Time Intervals

Table 8 Changes in Mean P.H of the ABG valve at Different Time Intervals

Intervals	pH	
	MEAN	±SD
Upon-Admission	7.29	±0.06
1st Hour	7.33	±0.05
4th Hour	7.35	±0.67
Statistical Inference	**P - value: Admission and 1 hour:** < 0.00001 **Admission to 4 hour:** 0.850	

The mean pH at admission was 7.29 with a standard deviation (SD) of 0.06. 1 hour after starting NIMV, the mean pH increased to 7.33 with an SD of 0.05, showing a statistically significant difference. By the 4th hour, the mean pH further increased to 7.35 with standard deviation of 0.67, there were statistical significance difference

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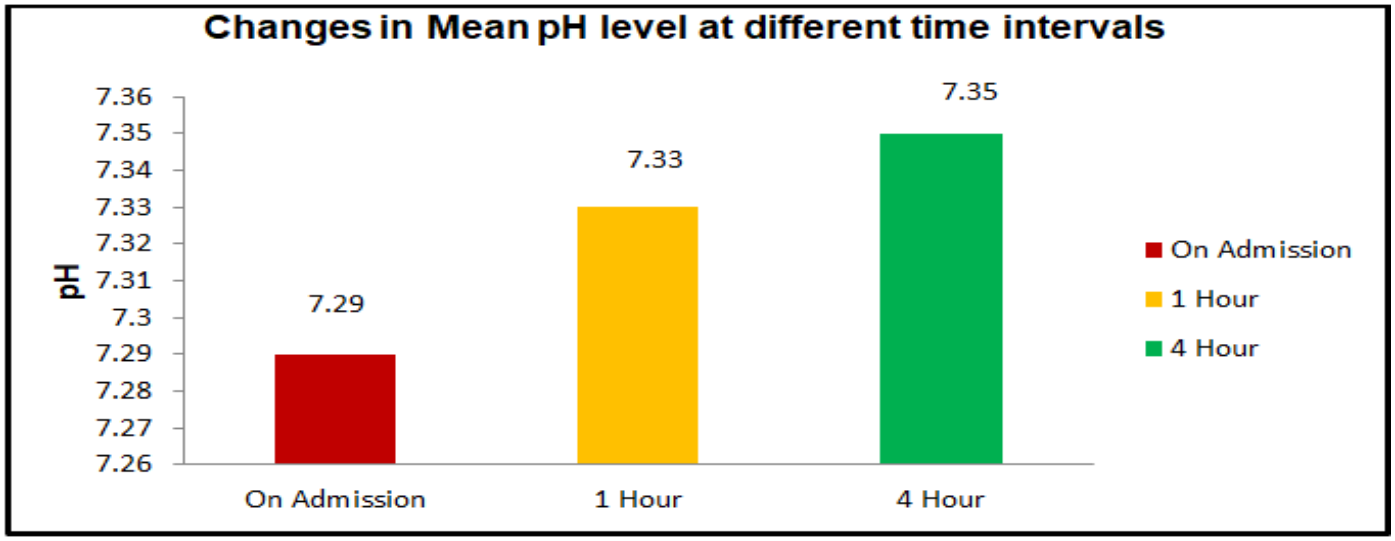

Fig 8 Graph Illustrating the Changes in Mean pH Level at Different Intervals

Table 9 Changes in Mean Partial Pressure of Oxygen Values of the A.B.G Different Interval

Intervals	PaO_2 (mmHg)	
	MEAN	±SD
Upon Admission	69.80	±06.31
1st Hour	81.46	±08.05
4th Hour	88.01	±10.96
Statistical Inference	**p-value for Admission and 1hour :** < 0.00001 **Admission to 4 hour:** < 0.00001	

The mean PaO_2 at admission was 69.80 with a standard deviation (S.D) of 6.31. 1st hour after starting NIMV, the mean PaO2 increased to 81.46 with an S.D of 8.05, showing a statistically significant difference. By the 4th hours, the mean PaO2 further increased to 88.01 with an SD of 10.96 there were statistical significance difference

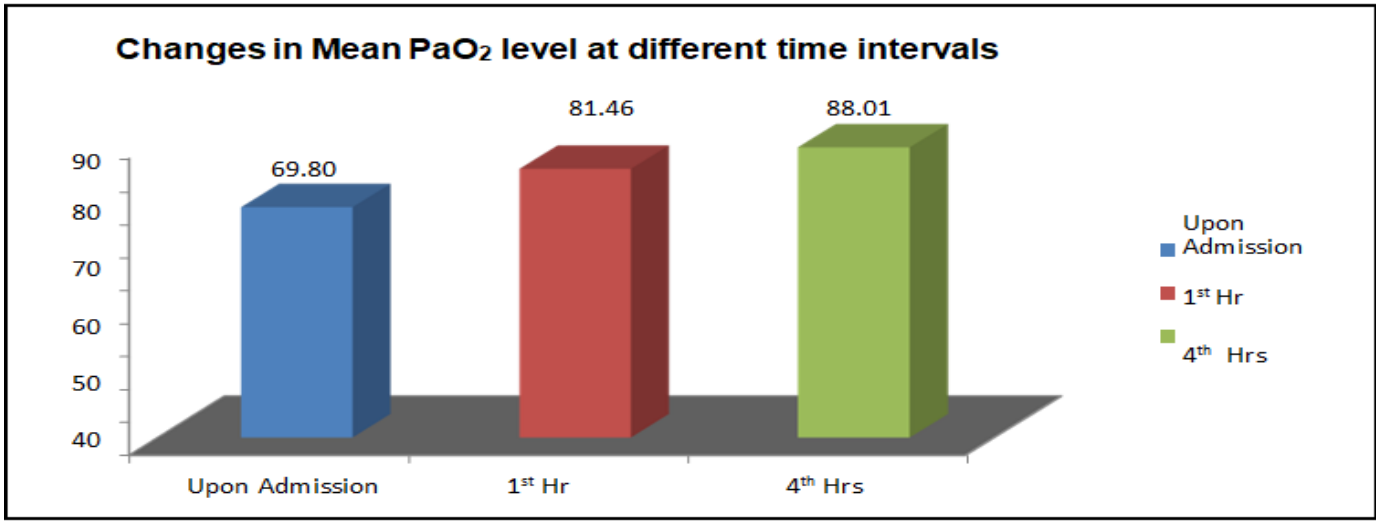

Fig 9 Graph Illustrating the Changes in Mean (PaO_2) at Different Time Intervals

Table 10 Change in Mean Partial Pressure of Carbon Dioxide of the A.B.G Valves at Different Interval

Intervals	$PaCO_2$ (mmHg)	
	MEAN	± SD
Upon Admission	66.20	±04.55
1st Hour	59.03	±05.01
4th Hour	53.85	±07.89
Statistical Inference	**p-value for Admission to 1hour:** < 0.00001 **Admission to 4 hour:** < 0.00001	

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The mean $PaCO_2$ on admission was 66.20 mmHg with a S.D of 4.55. 1st hour after starting NIMV, the mean $PaCO_2$ decreased to 59.03 mmHg with an S.D of 5.01, indicating a statistically significant change. By the 4th hours, the mean $PaCO_2$ further decreased to 53.85 mmHg with an S.D of 7.89 there were statistical significance difference.

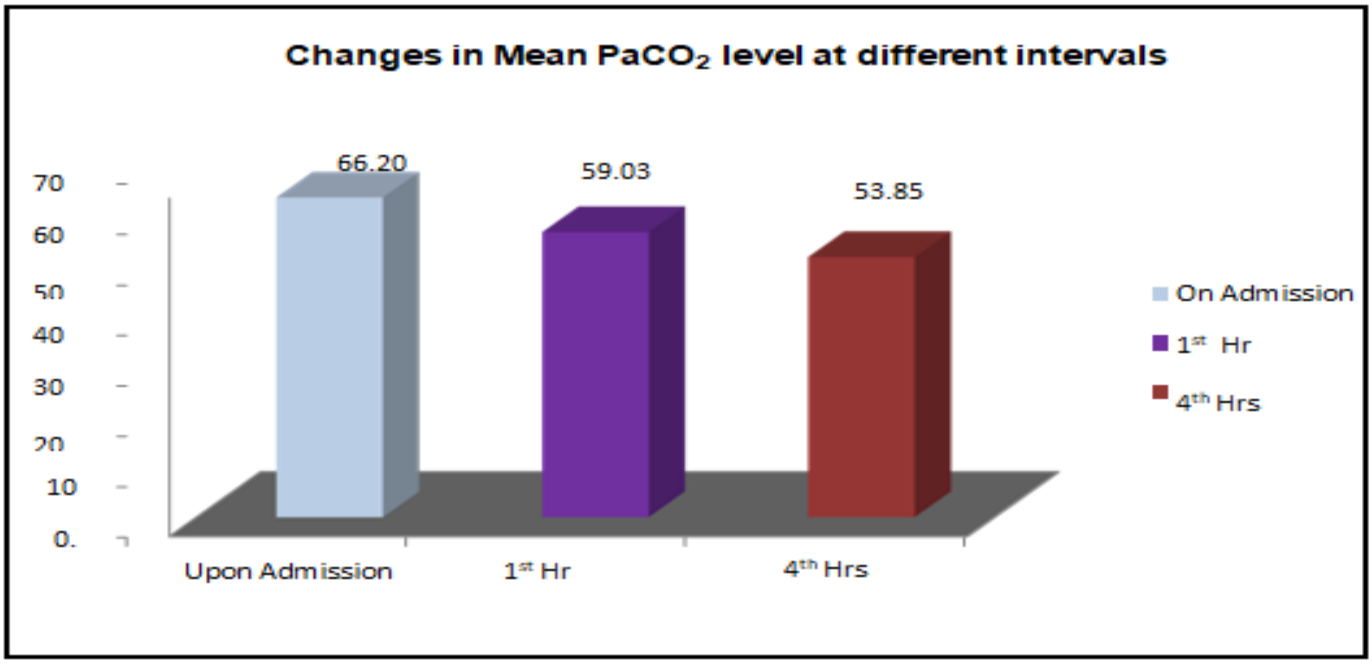

Fig 10 Graph Illustrating Change of Mean $PaCO_2$ at Different Interval

Table 11 Change Mean HCO_3 Values of A.B.G Different Intervals

Intervals	HCO_3 (mEq/L)	
	MEAN	± SD
Upon Admission	21.19	±01.20
1st Hour	22.13	±01.13
4th Hour	22.50	±01.83
Statistical Inference	P value for Admission and 1st hr: < 0.00001 Admission to 4 hour: < 0.00001	

The mean HCO_3 at admission were 21.19 with a standard deviation of 1.20. 1st hour after starting NIMV, the mean HCO_3 increased to 22.13 with an S.D of 1.13, showing a statistically significant difference from the admission value. At the 4th hour after NIMV starting, the mean HCO_3 further increased to 22.50 with an S.D of 1.83, there were statistical significance difference.

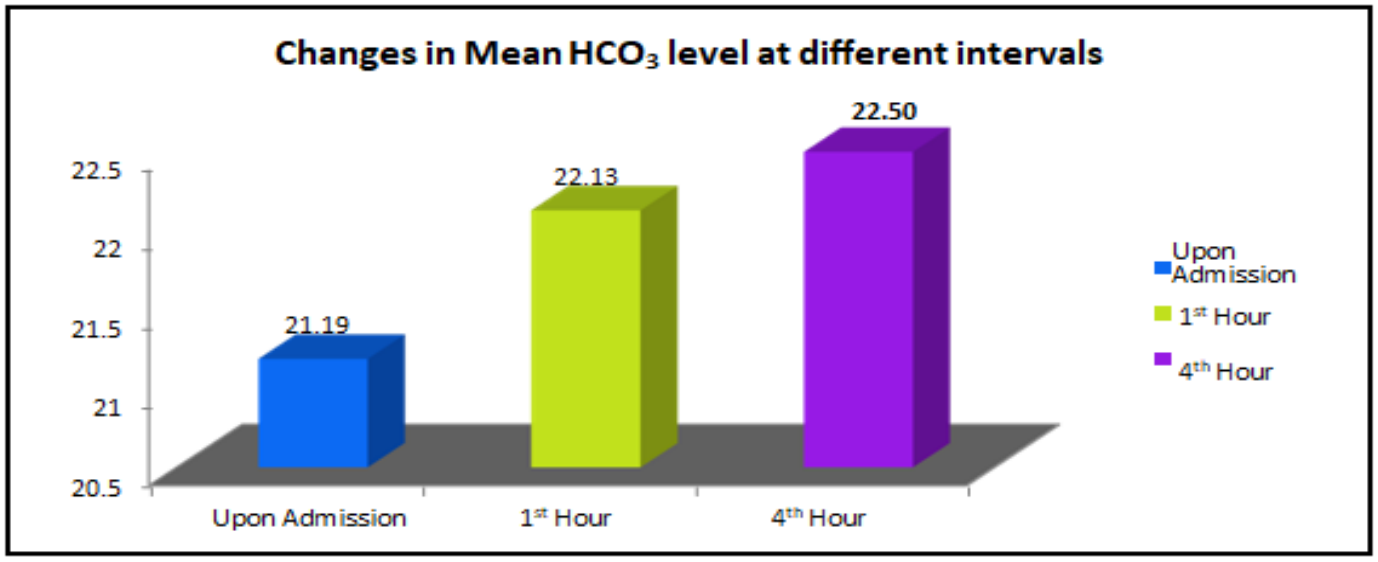

Fig 11 Graph Illustrating Change in Mean HCO_3 at Different Interval

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Table 12 Outcome after Receiving NIMV

Outcome	Frequency	Percentage
Recovered	88	88.0
Failed	12	12.0
Total	100	100.0

For the clinical assessment of all 100 patients, monitoring of vitals and arterial blood gas analysis was conducted. A total of 88 patients (88%) recovered

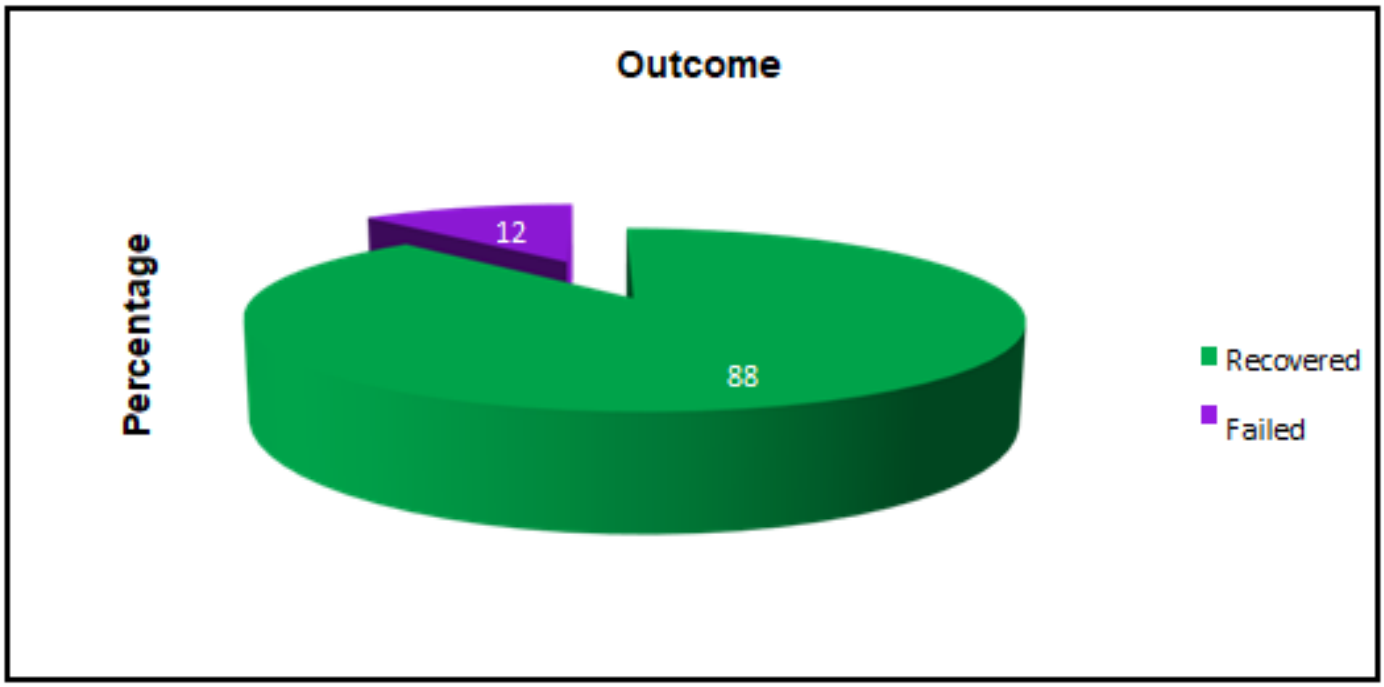

Fig 12 Graph Depicting the Distribution of Patients Based on their Outcomes after Receiving NIMV.

IV. DISCUSSION

Non-invasive mechanical ventilation (NIMV) is considered a viable therapeutic option for hospitalized patients experiencing T2RF because of A.E-COPD. There has been a shortage of data from India concerning its effectiveness in managing COPD. This study was perform to evaluating the effective of non-invasive mechanical ventilation in managing acute exacerbations of copd in a tertiary care centre hapur uttar Pradesh.

In present study average mean age is 63.32 + 9.31years. In our study of 100 patients, commodities were evaluated, revealing that 66 (82.5%) had hypertension, 24 (30%) had diabetes, 6 (7.5%) have been a past history of ischemic heart disease , and 7 (8.8%) have been a past history of Koch's. Only 14 (17.5%) had no co-morbid conditions.

Among those who recovered with NIMV, 15.9% (14) had no co-morbid conditions, while 84.1% had co-morbid conditions. No statistically significant difference was found between the presence of co-morbid conditions and the outcome of NIMV.

In our study 100 AECOPD patients were taken who were given NIMV trial. Out of 100 patients 88 recovered with the trial of NIMV. Several parameters like ABG, Respiratory Rate, Heart Rate, SPO_2, were measured at time interval of 1 hour and 4 hours .Our study showed there was significant improvement in these parameters with NIMV. 12 patients who didn't recover after NIMV were taken on mechanical ventilation. The failure of NIMVin these patients was may be due to the severity of disease and uncontrolled comorbid conditions.

NIMV represents a significant advancement in managing acute exacerbations of COPD, as it decreases the need for endotracheal intubation, thus reducing complications and hospital costs while improving survival rates. It has been applied across various clinical settings, including E.R, respiratory ward ,RICU and ICU.

V. CONCLUSION

The benefits of NIMV include a reduction in endo-tracheal intubation and death rates, reducing the length of hospitalization, cost effectiveness.

The study findings suggest that NIMV holds promise as a therapeutic approach for the management of A.ECOPD. After initiation results with significant improvements in arterial blood gas valves, leading to a decreased in the need for endotracheal intubation in these patients.

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