



Study of clinical profile of patients intubated and those on non invasive ventilation in Emergency Medicine Department

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Abstract

Background: An unobstructed, protected airway and adequate ventilation are critical to prevent hypoxemia. Emergency medicine is an emerging branch in India at present and no research has been conducted to evaluate baseline demographic features, indications, modes of ventilation etc for patients requiring mechanical ventilation in ED.

Methods: All patients requiring mechanical ventilation with age >12 years, not treated outside and admitted to emergency medicine department from July 2017 to September 2019 were included in our study. Data collected for each patient included age, sex, vitals on presentation i.e. temperature, pulse, BP, SpO₂, RR, GCS, systemic examination, diagnosis, mode of mechanical ventilation and ABG.

Results: 57% subjects were ventilated by invasive, 33% by non invasive ventilation and 10% by both mode of ventilation. Mean age of study subjects was 57.37±16.42. 67% of the patients were males and 33% were females. Most common diagnosis was COPD exacerbation. Of patients who were invasively ventilated, 63% were on volume assist mode and 4 % on pressure control mode. Out of 33 patients kept on NIV, 11 patients were on CPAP mode and rest 22 on PSV+CPAP mode. 42% patients had respiratory acidosis and 29% had metabolic acidosis. The subjects with lower GCS, low SpO₂ and raised RR on presentation required invasive mode. Among NIV and intubation group Systolic BP, Diastolic BP and Respiratory rate showed significant difference in mean values ($p < 0.05$).

Conclusion: This study provided information about recent epidemiological trends in our ED and may help derive a management protocol for better outcome of patients in future.

Introduction

Airway management is a critical need in many acutely ill and injured patients. Inadequate delivery of oxygen to brain and other vital structures is the quickest killer. An unobstructed, protected airway and adequate ventilation are critical to prevent hypoxemia.

Emergency airway management is the major key for successful resuscitation in ED. Emergency department deals with most of the cases with threatened airway and impending respiratory failure requiring mechanical ventilation. This early period of care has significant impact on the outcomes of these patients. Emergency medicine is an emerging

branch in India at present and no research study has been conducted to evaluate baseline demographic features, indications, difficult airway assessment, modes of ventilation etc for patients requiring mechanical ventilation in the ED setting.

Therefore by this observational study we try to study the baseline characteristics of patients requiring mechanical ventilation in ED settings.

Aim

To study the clinical profile of patients intubated and those on NIV in Emergency Department.

Objectives

1. To study various indications of need for mechanical ventilation.
2. To study the demographic features of patients on mechanical ventilation.
3. To assess how many patients can be managed with non invasive ventilation versus invasive ventilation in EM.
4. To tabulate different ventilator settings used.

Methodology

Study Design

Prospective observational study.

Place of Study

The present study was done on the patients in the Department of Emergency Medicine at Dr. D.Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune.

Study Duration

July 2017 to September 2019.

Study was scheduled as:

1. Preparatory phase: 1 month (synopsis submission for ethical clearance)
2. Case screening, recruitment and data collection: 16 months
3. Data analysis and writing : 3 months

Sample Size and Sampling Technique

The sample size was estimated based on single population proportion formula using a confidence

interval (CI) of 95% and a 40% invasive ventilation of previous study by Mohamed A. Zamzama, Amal A. Abd El Aziza, et al.^[2] and acceptable difference of 10% using sample size formula was 95.

$$N = z^2 pq / d^2$$

Where, n = sample size,

Z= 1.96

p = proportion of invasive ventilation

d = assumed marginal error.

Total 100 subjects were included in study. Participants were selected using convenience sampling technique.

Data Analysis

Data was entered into computer Microsoft Excel and exported to SPSS version 20 for analysis.

Continuous variables were expressed as mean \pm standard deviation or median (range) and categorical variables were expressed as number (percentage).

For categorical variable association between exposure and outcome variable was analysed using Chi square or Fisher exact test. P value < 0.05 was considered statistically significant.

Ethical Clearance

Study was conducted only after the clearance from ethical and scientific committee of this institution.

Inclusion Criteria

All the patients undergoing intubation and non-invasive ventilation in the emergency department during the period of study with age more than 12 years.

Exclusion Criteria

1. Age less than 12 years.
2. Pregnant
3. Presented to EM who had already taken treatment outside and intubated in the hospital where he / she was admitted previously.

Data Collection: Data collected for each patient includes age, sex, vitals on presentation i.e. temperature, pulse, BP, SpO₂, RR, GCS, systemic examination, diagnosis, mode of mechanical ventilation, and ABG.

Observations and Results

A cross-sectional observational study was conducted with 100 patients to Study the Clinical Profile of Patients Intubated and Those on Non-Invasive Ventilation in Emergency Medicine Department.

Distribution of invasive versus non-invasive ventilation:

57% subjects were ventilated by invasive, 33% by non invasive ventilation and 10% by both mode of ventilation (NIV followed by invasive ventilation)

Table 1 : Mode of Ventilation

Mode of ventilation	Frequency	Percentage
NIV	33	33.00%
Intubation	57	57.00%
both	10	10.00%
Total	100	100.00%

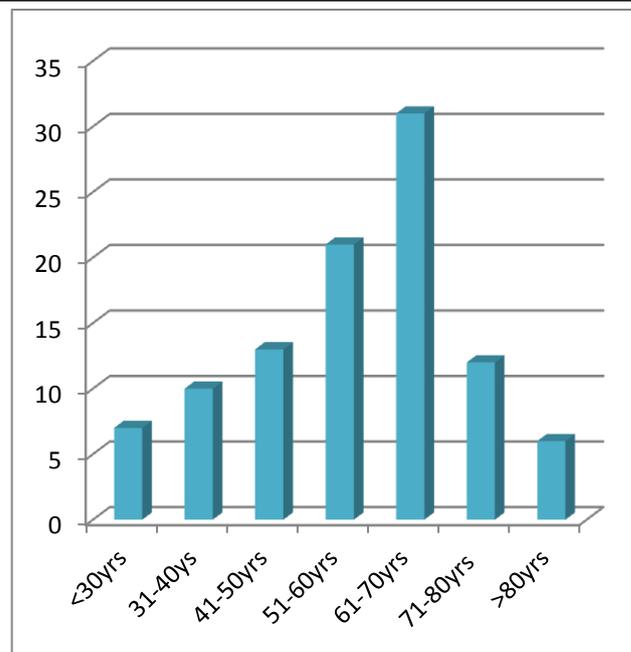


Figure 2: Age wise distribution of study subjects

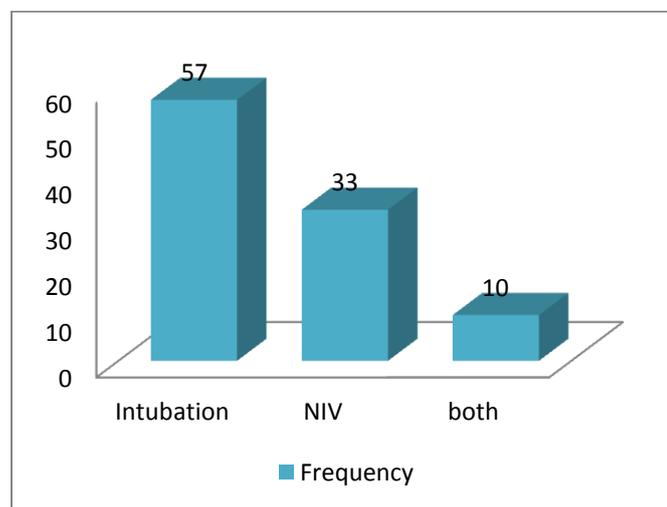


Figure 1: Mode of ventilation

Distribution of patients according to AGE

Maximum 31% subjects were in age group of 61-70yrs followed by 21% subjects in 51-60yrs 13% subjects in 41-50yrs and 12% subjects in 71-80yrs. Mean age of study subjects was 57.37+ 16.42 and total subjects were in age range of 16-87yrs.

Table 2: Age wise distribution of study subjects

Age group	Frequency	Percent
<30yrs	7	7.00%
31-40yrs	10	10.00%
41-50yrs	13	13.00%
51-60yrs	21	21.00%
61-70yrs	31	31.00%
71-80yrs	12	12.00%
>80yrs	6	6.00%
Total	100	100.00%

Type of ventilation required among age groups:

In our study it was found that there was increased requirement of intubation with increase in age. (Patients that were put on NIV as well as intubated were excluded from the following table)

Table 3: Type of ventilation required among Age group

Age group	Ventilation		Total
	NIV	Intubation	
<30yrs	3(50.00%)	3(50.00%)	6
31-40yrs	2(20.00%)	8(80.00%)	10
41-50yrs	6(46.15%)	7(53.85%)	13
51-60yrs	7(35.00%)	13(65.00%)	20
61-70yrs	13(46.43%)	15(53.57%)	28
71-80yrs	2(25.00%)	6(75.00%)	8
>80yrs	0	5(100.00%)	5
Total	33(36.67%)	57(63.33%)	90

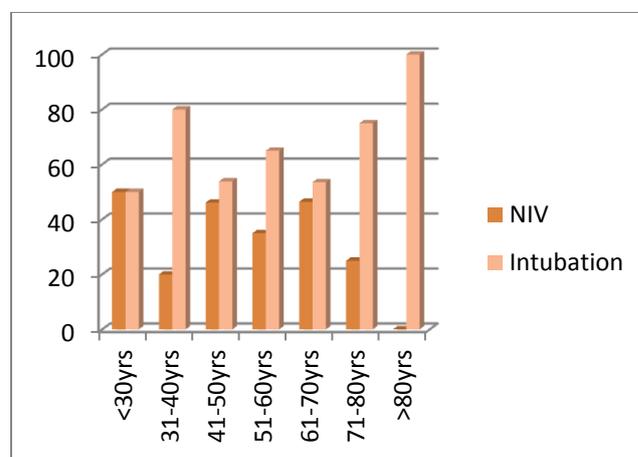


Figure 3: Type of ventilation required among age group

Distribution of patients according to gender

67% of the patients in our study were males, while female patients constituted 33% of the study population. Gender wise distribution in our study was M:F = 2.03:1

Table 4 : Gender wise distribution of study subjects

Gender	Frequency	Percent
Female	33	33.00%
Male	67	67.00%
Total	100	100.00%

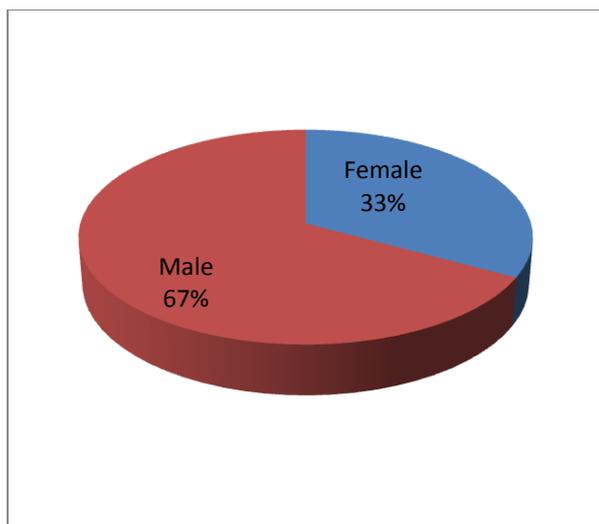


Figure 4: Gender wise distribution of study subjects

Type of ventilation required among male and female:

It was observed that there was no significant difference in non invasive or invasive mode of ventilation required for male and female subjects (p=0.951). 10 subjects who required both invasive and non invasive mode of mechanical ventilation were excluded from the following table.

Table 5: Type of ventilation required among male and female study subjects

Gender	Ventilation		Total
	NIV	Intubation	
Female	11(35.48%)	20(64.52%)	31
Male	22(37.29%)	37(62.71%)	59
Total	33(36.67%)	57(63.33%)	90

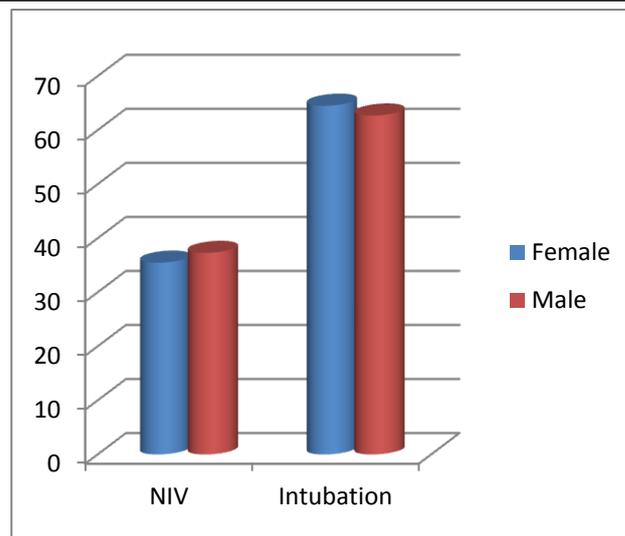


Figure 5: Type of ventilation required among male and female

Distribution of most prevalent diagnosis: Table shows most common diagnosis was COPD exacerbation (22%).

Table 6: Diagnosis distribution among study subjects

Diagnosis	Frequency	Percent
Acute Heart Failure without pulmonary edema	5	5.00%
Acute pulmonary edema	1	1.00%
ARDS	5	5.00%
Carcinoma breast	1	1.00%
Carcinoma Larynx	1	1.00%
Cardiac arrest(post resuscitation)	3	3.00%
Cardiogenic shock	5	5.00%
Chronic Liver Disease	1	1.00%
Chronic Kidney Disease	12	12.00%
COPD exacerbation	22	22.00%
Cor pulmonale	1	1.00%
Cerebrocasvascular accident	4	4.00%
Cerebral venous sinus thrombosis	1	1.00%
Diabetic Ketoacidosis	3	3.00%
Guillain-Barre syndrome	1	1.00%
Head injury	4	4.00%
Pulmonary Tuberculosis	2	2.00%
Intracranial hemorrhage	5	5.00%
Generalised Tonic Clonic Seizure	2	1.00%
Lower Respiratory Tract Infection	4	4.00%
Meningitis	2	2.00%
Myocardial infarction	5	5.00%
Phenol poisoning	1	1.00%
Pulmonary embolism	2	2.00%
Septic shock	6	6.00%
Tetanus	1	1.00%
Polytrauma	1	1.00%
Total	100	100.00%

Distribution of mode of NIV and invasive ventilation used among study subjects:

In this study, out of the patients who were invasively ventilated, 63% were on volume assist mode and 4 % on pressure control mode. Out of 33 patients kept on NIV 11 patients were on CPAP mode and rest 22 were kept on PSV+CPAP mode.

Table 7: Mode used for ventilation

Mode used	Frequency	Percent
CPAP	11	11.00%
PSV+CPAP	22	22
Pressure Control	4	4.00%
Volume Assist Mode	63	63.00%
Total	100	100.00%

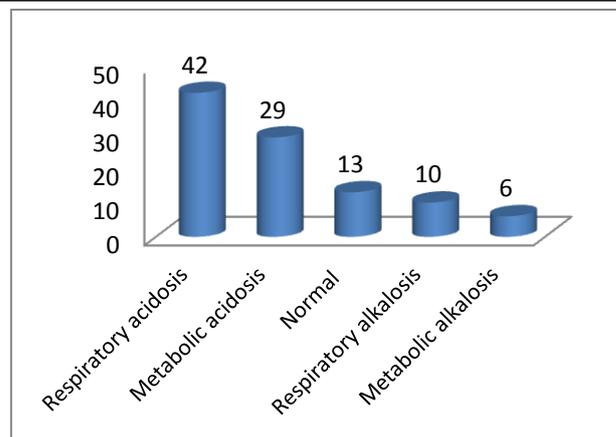


Figure 7: Distribution of ABG findings among study subjects.

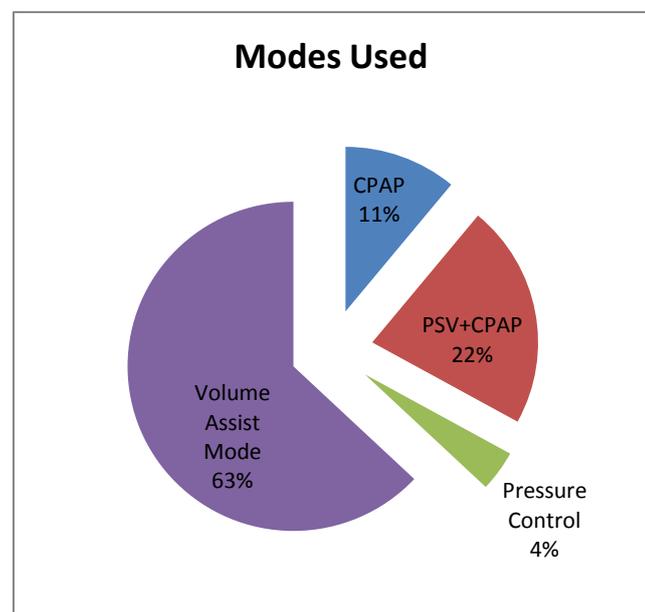


Figure 6: Mode used for ventilation

Distribution of ABG of patients with mechanical ventilation

It was observed that 42% subjects had respiratory acidosis, 29% had metabolic acidosis and 13% had normal findings on ABG analysis.

Table 8: Distribution of ABG findings among study subjects

ABG	Frequency	Percent
Respiratory acidosis	42	42.00%
Metabolic acidosis	29	29.00%
Normal	13	13.00%
Respiratory alkalosis	10	10.00%
Metabolic alkalosis	6	6.00%
Total	100	100.00%

Distribution of type of ventilation required among different ABG findings

In intubation group metabolic acidosis was found in majority of subjects while in NIV group respiratory acidosis was most commonly seen. 10 study subjects who required both NIV and invasive mode of ventilation were excluded from this table.

Table 9: ABG finding in NIV and Intubation group of study subjects

ABG	Ventilation		Total
	NIV	Intubation	
Metabolic acidosis	4(15.38%)	22(84.62%)	26
Metabolic alkalosis	0	6(100.00%)	6
Normal	1(7.69%)	12(92.31%)	13
Respiratory acidosis	24(64.86%)	13(35.14%)	37
Respiratory alkalosis	4(50.00%)	4(50.00%)	8
Total	33(36.67%)	57(63.33%)	90

12 Patients with normal ABG were kept on invasive mode of ventilation because their GCS was less than 8 and they couldn't protect their airway from aspiration, tongue fall etc. There were no ventilatory problems found in those subjects.

The diagnosis for these patients were as follows

Table 10: Diagnosis of patients with GCS <8 and normal ABG

Serial number	DIAGNOSIS	Number of patients
1)	CVA with HTN	2
2)	Meningitis	2
3)	Hypertensive Bleed	3
4)	Myocardial Infarction	3
5)	CVST	1
6)	Cardiogenic shock with IHD	1

Distribution of Glasgow coma scale among study subjects:

In our study it was found that out off 33 subjects who were put on NIV the GCS score was 15/15 (100%). However, among 57 subjects who were intubated, 16 subjects had GCS of less than 15 and 41 subjects had GCS 15 (intubated due to abnormal ventilation.). 10 patients with NIV failure and later intubated had GCS of 15/15 on initial evaluation. From the following table we observed that subjects with lower GCS on presentation required invasive ventilator support.

Table 11: Mode of ventilation required according to GCS.

GCS	Ventilation		Total
	NIV	Intubation	
<15	0	16(100.00%)	16
15	33(44.59%)	41(55.41%)	74
Total	33(36.67%)	57(63.33%)	90

Distribution of SpO2 among study subjects

We have found that the oxygen saturation of the peripheral blood (SpO₂) out of 80 subjects who were not maintaining saturation on high flow oxygen at presentation, 33 subjects were kept on NIV and 47 subjects were intubated. Also 10 subjects even with normal SpO₂ required intubation due to other indications. 10 subjects who were put on NIV followed by intubation were not included in this table.

Table 12: Mode of ventilation required depending on SpO₂.

SpO ₂	Ventilation		Total
	NIV	Intubation	
Decreased	33(41.25%)	47(58.75%)	80
Normal	0	10(100.00%)	10
Total	33(36.67%)	57(63.33%)	90

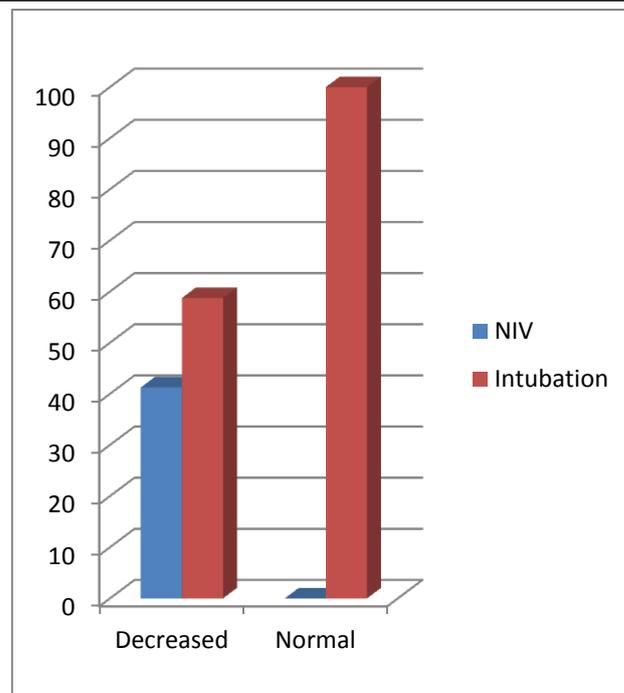


Figure 8: Mode of ventilation required depending on SpO₂.

Distribution of variables of general examination among study subjects

The general examination variables were tabulated and compared amongst the intubated subjects versus subjects on NIV. Median for systolic BP in NIV group was 140 while that for intubation group was 100. Median for diastolic BP in NIV group was 90 and those in intubation group were 63.

Median Respiratory rate for NIV group was 38 and that for intubation group is 32. We found that out of various parameters assessed among NIV and intubation group Systolic BP, Diastolic BP and Respiratory rate showed significant difference in mean values (p<0.05). Temperature, pulse and spo₂ did not show any significant variation in NIV and intubation group.

Table 13: Distribution of median value of variables (of general examination) in NIV and intubation group

Variables	NIV	Intubation	P value
	Median(Range)	Median(Range)	
Temperature	99 (98-102)	99 (98-104)	0.9285
Systolic BP,	140(92-182)	100(60-210)	0.006
Diastolic BP,	90(56-120)	63(30-130)	0.01
Respiratory rate	38(28-49)	32(10-52)	0.0032
Pulse	114(62-137)	119(43-157)	0.457
Spo ₂	84(60-92)	84(30-98)	0.4206

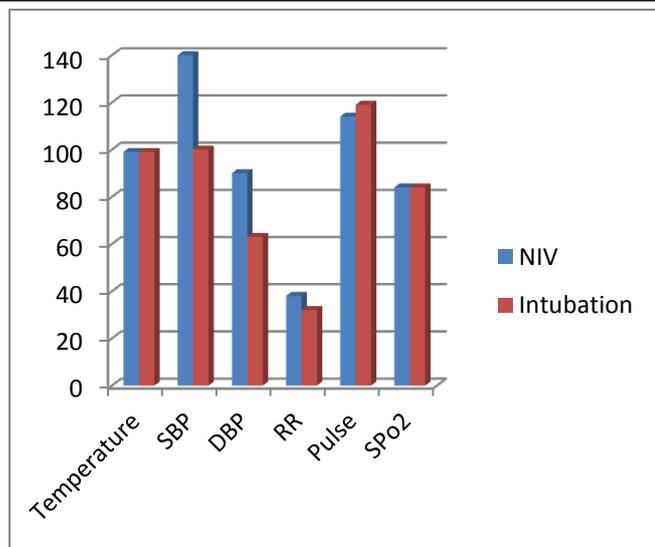


Figure 9: Distribution of median value of variables (of general examination) in NIV and intubation group.

Distribution of Raised Respiratory Rate

The cutoff for raised RR is taken as 25 in our study. We observed patients who required mechanical ventilation with $RR > 25$, 42 were kept on NIV and 44 required invasive mode of ventilation.

Discussion

This observational study is conducted with 100 patients aimed at evaluating the clinical profile of patients intubated and those on NIV in ED.

Mode of Ventilation

In this study we have found that out of 100 patients who required ventilation; 57% were invasively ventilated, 33% were on NIV and those who required intubation after NIV due to NIV failure were 10%. This is similar to a study by Venkatram, et al.^[1] In which 59% of the patients were subjected to IMV, 35.6% subjected to NIMV and 5.45% of the patients demonstrated NIMV failure and needed endotracheal intubation. Similar study was conducted by Mohamad A Zamzam, et al which included 130 patients subjected to Mechanical Ventilation (MV); divided into three groups according to the type of MV: Group A: Invasive Mechanical Ventilation: 52 patients (40%), Group B: Non Invasive Mechanical Ventilation : 66 patients (50.77%) and Group C: NIMV failure that needed IMV: 12 patients(9.23%)^[2]

Distribution according to Age

In the present study Maximum 31% subjects were in age group of 61-70yrs followed by 21% subjects in 51-60yrs 13% subjects in 41-50yrs and 12% subjects in 71-80yrs. Mean age of study subjects was 57.37 ± 16.42 . This was similar to the study conducted by Mohamed A. Zamzama, et al that demonstrated the mean age of all the studied patients was 58.47 ± 8.2 years^[2].

Also it was found that there was increased requirement of invasive mechanical ventilation with increase in age.

Our study was in agreement with a study done by Venkatram et al., Paolo et al. and Antonelli et al.^[1,3,4], the need for IMV in the older age.

Gender Distribution

In present study the subjects were predominantly males (67%) than females (33%) with gender-wise distribution of study subjects. M:F was 2.03:1. Male subjects required mechanical ventilation more than female subjects. However the percentage of males requiring intubation was 62.71% and male subjects requiring NIV was 37.29%. On the other hand females requiring intubation were 64.52% and female subjects requiring NIV were 35.48%. There was no significant difference in mode of ventilation (invasive or non invasive) required for male and female subjects ($p=0.951$).

This was in agreement with studies by Esteban et al.^[5] and Kubler et al.^[6] which showed that men account for more than half of the patients receiving mechanical ventilation in ICU. They explained this by the commonest etiology of respiratory failure and so-often MV was COPD which is more prevalent in males than females.

Distribution of diagnosis requiring mechanical ventilation

In our study we found that most prevalent diagnosis requiring mechanical ventilation was acute exacerbation of chronic obstructive pulmonary disease (22%), followed by Chronic Kidney disease (11%), and septic shock (6%).

Kubler et al.^[6] showed the commonest etiology of respiratory failure leading to IMV and NIMV was

COPD (14% and 44% respectively) followed by ARDS, pneumonia, cardiogenic pulmonary edema and others in IMV.

Distribution of mode of mechanical ventilation used in study subjects

In this study, out of the patients who were invasively ventilated, 63% were on volume assist mode and 4 % on pressure control mode. Out of 33 patients kept on NIV 11 patients were on CPAP mode and rest 22 were kept on PSV+CPAP mode.

This differs from the study by Mohamed A Zamzam , et al where the most common initial mode of MV in group A was IPPV (intermittent positive pressure ventilation;76.9%) followed by SIMV (synchronised intermittent mandatory ventilation; 23.1%). In NIMV, the modes were BiPAP(84.9%) followed by CPAP (15.2%).

Distribution of ABG findings in study group

It was observed that 42% subjects had respiratory acidosis, 29% had metabolic acidosis and 13% had normal findings on ABG analysis. In intubation group metabolic acidosis was found in majority of subjects while in NIV group respiratory acidosis was most commonly seen. There were 12 Patients with normal ABG who were kept on invasive ventilation because they were intubated with indication of GCS <8. They had no ventilatory abnormality.

This differs from studies by Confalonieri et al^[7], Massimo et al.^[8] and Shirakabe et al^[9] that showed that lower pH increases the risk of IMV.

Distribution of GCS on presentation

In our study it was found that out off 33 subjects who were put on NIV the GCS score was 15/15. However, among 57 subjects who were intubated, 16 subjects had GCS of less than 15 and 41 subjects had GCS 15.

This differs from the study by Duncan R et al^[10] who did an observational study on patients presenting with decreased consciousness admitted in ED. They concluded that it can be safe to observe poisoned patients with decreased consciousness, even if they have a GCS of 8 or less, in the ED.

Distribution of SpO₂ among study subjects

In present study we found that out of 80 subjects who presented with decreased SpO₂ on room air and not maintained SpO₂ after giving high flow oxygen at presentation, 33 subjects were kept on NIV and 47 subjects were intubated. Also 10 subjects with normal SpO₂ were intubated due to other reasons like low GCS.

This differed from the the study by Spada et al.^[11] who analyzed the SpO₂ and demonstrated that greater SpO₂ was associated with NIV success.

Distribution of General examination variables among study subjects

In present study, the general examination variables were tabulated and amongst the intubated subjects versus subjects on NIV. We found that out of various parameters assessed among NIV and intubation group Systolic BP, Diastolic BP and Respiratory rate showed significant difference in mean values (p<0.05).

The cutoff for raised RR is taken as 25 in our study. We observed patients who required mechanical ventilation with RR>25, 42 were kept on NIV and 44 required invasive mode of ventilation.

In the study by Chalmers JD, Singanayagam A, et al^[12] demonstrated that on admission blood pressure can predict 30 day mortality and need for mechanical ventilation and/or inotropic support in patients admitted with community acquired pneumonia. They concluded that with reducing systolic blood pressure, diastolic blood pressure, mean arterial pressure and pulse pressure there was increasing 30 day mortality and need for mechanical ventilation.

Another study done by Ivete Alonso Bredda Saad, Juliana Nalin de Souza Passarini, et al with aim to evaluate predictors of success or failure of NIV in an emergency department, demonstrated that respiratory rate above 25 may be associated with progression to invasive ventilation.^[13]

Conclusion

This observational study concludes that the invasive mode of mechanical ventilation is more common in our ED. Amongst the demographic features, we

found that as the age increases chances of invasive mode of mechanical ventilation also increases. However gender does not affect the choice of mode of mechanical ventilation.

The most common mode of invasive ventilation used is volume assist mode and for NIV mode 22 patients were on CPAP + PSV mode and 11 were on CPAP mode.

The most prevalent diagnosis for mechanical ventilation is COPD exacerbation and respiratory acidosis on ABG. Low SpO₂, increased respiratory rate, low systolic and diastolic BP and low GCS on presentation were more associated with invasive mode of ventilation and can help to predict the need for invasive mode mechanical ventilation.

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