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Original Research Article

Aetiology and Predictors of Outcome of Mechanically Ventilated Patients Admitted in Intensive Care Unit of a Rural Tertiary Health Care Center

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Abstract

Background: The need for mechanical ventilation (MV) is a frequent reason for admission to an intensive care unit (ICU). The principal indications for MV are airway protection and respiratory failure which are considered the most common vital organ failure seen in critically ill patients.
Aims and Objectives: To identify the aetiologies leading to MV and predictors of outcome in patients on MV.
Methods: Total 138 patients of both sexes admitted to MICU of tertiary care hospital having age > 12 years and who was subjected to invasive MV were included in the study. Different demographic, clinical and laboratory variables were recorded at the time of admission, during the ICU stay and at time of discharge.
Results: Mean age of the patients was 43.22 years, ranging from 14-75 years with male predominance (73.91%). The most common etiology for MV was poisoning (53.6%). The mortality was 42.1%. Total 77 patients required tracheostomy and 35 patients required inotropes support with mortality of 31.1% and 62.8 % respectively. The mean length of stay in ICU before MV, on MV and total length of stay in ICU in survivors was 0.9, 6.11 and 9 day while in non survivors was 0.78, 5.9 and 6.4 days respectively. The PaO_2/FiO_2 ratio in survivors was 282.87 while in non survivors it was 198.68. The mean GCS, APACHE II and SOFA score was 8.62, 16.26 and 7.84 in survivors while it was 6.47, 24.4 and 10.62 in non survivors respectively.
Conclusion: The most common etiology was poisoning. The age, coronary artery disease and hypertension, hypotension on presentation, use of tracheostomy and inotropes, total duration of ICU stay, all ABG parameters were significant predictors of outcome but tracheostomy was a better predictor of outcome while increased duration of stay in ICU also leads to improved outcome.
Keywords: Mechanical ventilation, Intensive care unit, Aetiologies, Predictors, Tracheostomy, Inotropes support, Mortality.

1. Introduction

The Acute respiratory failure is a frequent cause of admissions to intensive care units [1]. Invasive mechanical ventilation (IMV) is an important lifesaving tool of critical care medicine [2]. But there are very limited studies available regarding the utilization of mechanical ventilation. In one study it was shown that while only 2.8% of patients admitted to hospitals require IMV, but it contributes to 12% of hospital costs [3]. There are many factors present on day 1 which predict the outcome of patients receiving critical care, for which several scoring systems are designed [4].

Scoring systems are not the baseline for treatment in critically ill patients, but it helps in improving clinical decisions and identifying patients with unexpected outcomes. Use of these scoring systems also helps in making right clinical decisions and also in reducing hospital costs. They have become essential to describe ICU

populations and to explain differences in mortality [5]. While studies conducted in western countries shows that the mortality of patients receiving IMV is around 35%(6–10), there are lots of studies conducted in tertiary care centres of developing countries which shows a lot more mortality than west [6,7].

Still there is very scarce data available on the characteristics, aetiology, and predictors of mortality from India. Hence, present study was done to evaluate the APACHE II score and SOFA score along with other variables that can affect the outcome of patients on IMV. These scores and predictors are important for resource poor tertiary centers so that hospital resources can be used wisely and also help in understanding the prognosis of disease so that timely steps can be taken for the benefit of patient.

2. Materials and Methods

After obtaining Institutional Ethical Committee approval, this hospital based cross sectional observational study was conducted in 138 patients of both sexes admitted to MICU of tertiary care hospital having age > 12 years and who were subjected to IMV via endotracheal tube (ETT) or tracheostomy tube (TOT). Patients receiving non – invasive mechanical ventilation without subsequent intubation, patients of age <12 years, who took DAMA (discharge against medical advice) during the period of IMV, those patients intubated outside the hospital, who succumbed within 24 hours of instituting mechanical ventilation were excluded from the study.

Demographic details, symptoms like dyspnoea, cyanosis, restlessness, sweating and altered sensorium were recorded just before applying mechanical ventilation and signs like pulse, blood pressure, temperature, respiratory rate, pallor, icterus, clubbing and cyanosis were noted. Etiology and patient's co-morbid conditions like ischemic heart disease, hypertension, diabetes mellitus, COPD, CKD, tuberculosis, alcoholism, and smoker were recorded. Complete blood counts, liver function tests, kidney function tests, random blood sugar levels and serum electrolytes were investigated. Supportive measures like tracheostomy procedures and inotropic support when done in patients were recorded. Arterial blood gas analysis was done in first 24 hours of mechanical ventilator application and pH, PaO_2, $PaCO_2$ and bicarbonate levels (HCO_3-) were noted. Glasgow coma scale just before mechanical ventilator application was recorded. PaO_2/FiO_2 was recorded in 1st 24 hours of mechanical ventilator application. Apache II score and SOFA score on Day 1 of mechanical ventilation was calculated. Total duration before MV, on MV and total duration of ICU stay were recorded. Complications such as ventilator associated pneumonia, hepatic failure; renal failure and sepsis were noted. Patient's outcome in the form of survivor and non-survivor were observed.

2.1 Data Analysis

Collected data was entered in MS-Excel Office 2007 and corrected for typographic errors and analyzed using SPSS version 16.0. The comparison of qualitative data was done by using chi-square test. The confidence limit for significance was fixed at 95% level with p-value <0.05.

3. Observations and Results

Total 138 patients were studied; during the study period from January 2016 to November 2017.There were 102 males and 36 were females, the ratio of male to female being 2.83: 1. The mean age of patients was 43.22 years, ranging from 14 to 75 years. The most common etiology for MV was poisoning (53.6%), while second most etiology was ARDS, 14 (10.1 %), (Table 1).

Table 1: Etiology of Mechanical Ventilation

Diagnosis	No. Patients (%)
ARDS	14 (10.1%0
CKD with pulmonary edema	6 (4.3%)
COPD with Secondary Infection With Acute Exacerbation	3 (2.1%)
CVE C COMA	4 (2.8%)
DM C DKA	4 (2.8%)
Meningitis	6 (4.3%)
Other	10 (7.2%)
Poisoning	74 (53.6%)
Septicemia	4 (2.8%)
Snake Bite	13 (9.4%)

Out of 138 patients, 58 patients did not survive, while 80 patients survived, giving a mortality of 42.1%. Mean age of the survivors and non survivors was 40.61 and 46.81 years respectively, (p=0.018). Of the total females 18 cases survived while 18 cases succumbed, giving a mortality of 50%, while in males 62 cases survived and 40 cases succumbed, giving a mortality of 55.1%, (p=0.26). The majority of patients presented with altered sensorium (106 patients) followed by restlessness, sweating and bluish discoloration of lips fingers and ears. The co-morbidities were alcoholic (n=64), smoker (n=58), Hypertension (41), Diabetes mellitus (35), Coronary artery disease (30), COPD (16), CKD (10) and tuberculosis (9). The mortality in clinical features and co-morbidities were shown in table 2.

Table 2: Clinical Features and Co morbid Conditions as Predictors of Outcome in Mechanically Ventilated Patients

Predictors		Outcome			P value
		Survivor (n=80)	Non-Survivor (n=58)	Total	
Clinical Features on Presentation	Bluish Discoloration	26(43.3%)	34(56.7)%	60 (100%)	0.002
	Restlessness	53(59.5%)	36(40.5%)	89 (100%)	0.612
	Altered Sensorium	57(53.7%)	49(46.3%)	106 (100%)	0.105
	Sweating	50(64.1%)	28(35.9%)	78 (100%)	0.096
Co-morbid Conditions	Coronary Artery Disease	12 (40%)	18 (60%)	30 (100%)	0.024
	Hypertension	18 (43.9%)	23 (56.1%)	41 (100%)	0.029
	Diabetes Mellitus	17 (48.5%)	18 (51.5%)	35 (100%)	0.192
	COPD	8 (50%)	8 (50%)	16 (100%)	0.492
	CKD	2 (20%)	8 (80%)	10 (100%)	0.012
	Alcohol Consumption	40 (62.5%)	24 (37.5%)	64 (100%)	0.316
	Smoking	36 (62%)	22 (38%)	58 (100%)	0.406
	Tuberculosis	4 (44.4%)	5 (65.6%)	9 (100%)	0.395

Seventeen patients were having bradycardia, 41 were having normal heart rate while 80 patients were having tachycardia, the mortality being 47.1% in bradycardia group, 34.1% in normocardia and 45% in tachycardia group, (p= 0.47). Out of 138 patients, 77 (55.7%) had normal B.P. 27 (19.5%) had hypertension and 34 (24.6%) had hypotension. The mortality in hypertensive group was 60%, in hypotensive group it was 64% while in normotensive group it was 26%.56 patients were having hyperthermia, 17 were having hypothermia and 65 were having normal temperature. The mortality was 50% in hyperthermia group, 58.9% in hypothermia and 30.7% in normal temperature group, (p=0.033).

The mean haemoglobin was 11.047g/dl in survivors and 9.49 g/dl in non survivors (p=0.00), the total counts were having a mean value of 9595.6/cumm in survivors and 11161/cumm in non survivors, (p=0.129). The survivors were having mean platelet count of 182,990/cumm and in non survivors the value was 142040/cumm, (p=0.017). The mean sodium level was 137.69 meq/l in survivors and 134.03 meq/l in non survivors. The mean potassium level was 3.97 meq/l in survivors and 4.00 meq/l in non survivors.

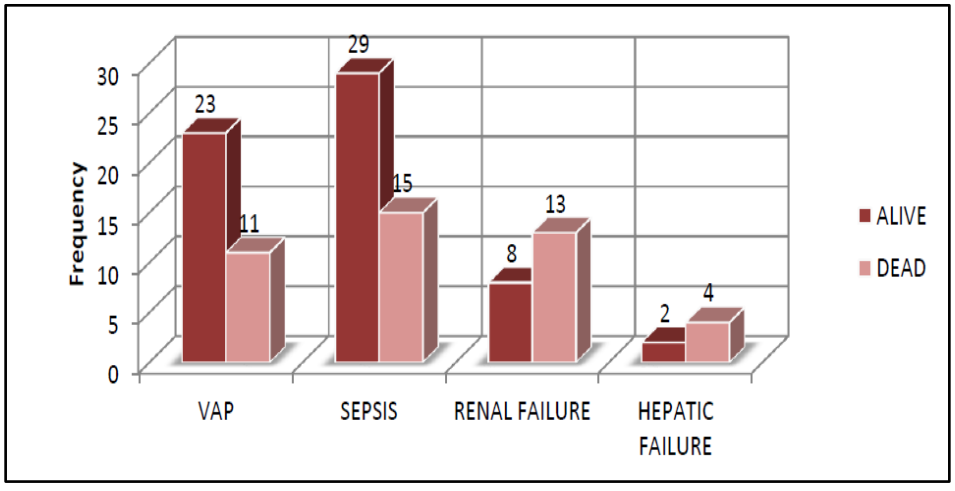
Total 77 patients required tracheostomy and 35 patients required inotropes support with mortality of 31.1% and 62.8 % respectively. The mean length of stay in ICU before MV, on MV and total length of stay in ICU in survivors was 0.9, 6.11 and 9 day while in non survivors was 0.78, 5.9 and 6.4 days respectively. Patient's Arterial blood gas analysis was shown in table 3.

Table 3: Arterial Blood Gas Indices as a Predictor of Outcome in Mechanically Ventilated Patients

ABG Indices	Outcome	Mean ± SD	P value
pH	Survivors	7.4±0.167	0
	Non-Survivors	7.26±0.19	
$PaCO_2$	Survivors	34.95±11.57	0.02
	Non-Survivors	40.26±14.933	
PaO_2	Survivors	203.38±78.839	0
	Non-Survivors	145.38±77.276	
HCO_3	Survivors	20.38±4.018	0.04
	Non-Survivors	18.49±6.647	
PaO_2/FiO_2	Survivors	282.8781±106.6144	0.0001
	Non-Survivors	198.681±113.3093	

The mean GCS score among the survived cases was 8.62 ± 2.058 and among the expired patients was 6.47±2.657, suggesting that non- survivors had significantly lower GCS (p=0.00). Similarly the mean APACHE score in the survivors was 16.26 ±5.942 and in the non-survivors was 24.4 ±9.27, the difference being statistically significant (p=0.00) implying that mortality increases with higher APACHE score. Mean SOFA score in the alive patients was 7.84 ±2.548 and in the died patients was 10.62 ±3.717 inferring that expired patients had significantly higher SOFA score with p-value = 0.00. Most common complication noted was sepsis followed by VAP, renal and hepatic failure as shown in figure 1.

Figure 1: Complications during Mechanical Ventilation as a Predictor of Outcome



4. Discussion

The hospital mortality rate of patients who required MV was 42.1%, it was similar to previous studies [8-10]. The mortality in females was 50%, while in males it was 55.1%, which was only slightly different from a study conducted by Azevedo *et al* [11], with mortality in females 43.4% and mortality in males 40.2%, while, it was markedly different in study done by Esteban *et al* [9]; with mortality of 31% and 30% in female and males respectively. In all the above mentioned studies including the present study sex of the patient was not an important predictor of outcome. The difference in mortality and the varied distribution of sexes in study population couldn't be explained. The most common diagnosis for mechanical ventilation was Acute poisoning (53.6%) followed by ARDS (10%), snake bite (9.4%) and other (7.2%). There were multiple overlapping co-morbid conditions in the present study; of these, coronary artery disease (mortality-60%), hypertension (mortality- 56%) and CKD (mortality-80%) showed significant association with outcome. Similarly findings were reported in previous studies [11-13].

60% of patients had tachycardia out of which 55% patient survived and rest (45%) died while 17 patients had bradycardia with 57.9% mortality the results being statistically insignificant (p= 0.47). It was similar to study conducted by Chiwhane *et al* [12]. There was 60% death observed in the study out of all hypertensive patients and 64% death out of hypotensive patients, (p = 0.00). Thus from present study it can be seen that hypotension is associated with outcome. The majority of mechanically ventilated patients had normal temperature (65) of which 69.3% survived whereas 56 had hyperthermia of which 50 % died and 50 % survived. There were 17 patients who had hypothermia of which 58.9% died making the result statistically significant (p=0.033). The respiratory rate was not significantly associated with the outcome; this finding was correlated with the study done by Madkour *et al* [14].

There was no significant difference observed between survivor and non-survivor group with regards to mean duration of stay before ventilation and on ventilation but significant difference observed amongst groups with regards to mean duration of total ICU stay. In present study it was seen that longer the duration of mechanical ventilation and longer the duration of ICU stay, the better prognosis is, this fact was supported by Sudarsanam *et al* [6] while in study done by Madkour *et al* [14] supports the opposite. The reason can be that this study has large number of COPD patients whose prognosis gets worse after prolong ventilation, while in current study the majority of patients were of poisoning and other diseases were acute in nature, thus the patients that succumbed were the patients whose general condition was already poor, or who had been subjected to prolonged hypoxia before being mechanically ventilated, due to referral from peripheral centres this point was supported by study conducted by Bhattacharya *et al* [15]. Thus it can be concluded from present study that the patients who are having no previous lung injury have better outcome if duration of mechanical ventilation is more than 6 days the outcome is good. While the same cannot be said regarding the patients with already diseased lungs subjected to mechanical ventilation.

There were 77 patients who required tracheostomy, out of which 24 patients succumbed giving a mortality of 31.1%. In a study conducted by Wu *et al* [16] the tracheostomy and translaryngeal ventilation modes were compared, they reported decreased in hospital mortality was 30.76% in tracheostomized patients while in translaryngeal ventilation the mortality was 44.93% the difference being significant. Thus it can be concluded that, though several studies have contradictory opinion regarding the benefit of tracheostomy but this procedure do help in reducing dead space, and also easy toileting of the airways. Thus it improves the prognosis of outcome. There were 35 patients required inotropic support in the current study, out of which 22 patients succumbed giving a mortality of 62.8%. Thus

the use of inotropic support is a significant predictor of outcome in MV, with its use predicting a poor outcome.

There are many studies which suggest that hypocarbia is a risk factor for poor outcome like in study done by Helmerhost *et al* [17], hypocapnia and hypercapnia was a bad prognostic factor when compared with normocapnia while comparing hypocapnia with hypercapnia, hypocapnia appears to be worse prognostic factor. In present study, the mean $PaCO_2$ in the non survivors was 40.26 while in the survivors was 34.95. The disparity between the findings of present study and other studies can be because of the timing of the sample taken, because in rest of the studies the ABG sample was drawn before instituting the mechanical ventilation. While in present study samples were drawn after instituting the MV, so in a way, though not causally associated, it can be said that patients whose hypercarbia was not responding to MV within first 24 hours had a poor prognosis. Likewise the mean PaO_2 in the non survivors group was 145.38 and in the survivors was 203.38 and mean HCO_3- in the non survivors was 18.49 while in survivors it was 20.38 with significant p value, suggesting that decrease in bicarbonate levels in blood is associated with poor outcome.

The patients who did not survive had lesser value of mean pH (7.26) on ABG than those who survived (mean pH was 7.4), the difference being statistically significant (0.00). The PaO_2/FiO_2 ratio in the population was 242.5 while in survivors it was 282.9 and in the non survivors it was 198.68 with p-value 0.00 indicating that low PaO_2/FiO_2 is associated with mortality. In a study done by Azevedo *et al* [11] the mean PaO_2/FiO_2 was 257 while in survivors it was 260 while in non survivors it was 250 the difference being significant. Thus it proves that PaO_2/FiO_2 has a significant association with the outcome. The mean APACHE score in the survivors was 16.26 and in the non-survivors was 24.4, the difference being statistically significant (p=0.00) implying that mortality increases with higher APACHE score. Mean SOFA score in the alive patients was 7.84 and in the nonsurvivors it was 10.62 inferring that expired patients had significantly higher SOFA score with p-value = 0.00. The mean GCS score among the survived cases was 8.62 and among the expired patients was 6.47, suggesting that non- survivors had significantly lower GCS (p=0.00). However, in a study conducted by Zamzam *et al* [18], they concluded that Day 1 GCS just before intubation has a good association with outcome of patients.

The mortality due to VAP was 32.4%, while with sepsis it was 34%, with acute renal failure it was 62%, and with acute hepatic failure, the mortality was 66.6%. Only acute renal failure showed significant association with the outcome. Whereas, though mortality was more in acute hepatic failure, the association was not significant, may be due to less number of cases. The reason for VAP and sepsis not occurring as a major predictor of mortality can be the large amount of poisoning patients in present study, as they are a cohort of comparably better health and normal organ systems as compared to patients with other diagnoses.

5. Conclusion

In the present study, most common etiology was poisoning and overall mortality was 42.1 %. The mortality was comparable to some developed nations ICU outcome; it indicates improved management of tertiary health care centres in India. The age, coronary artery disease and hypertension, hypotension on presentation, use of tracheostomy, use of inotropes, total duration of ICU stay, all ABG parameters, PaO_2/FiO_2 ratio and scores like GCS, SOFA, APACHE II, were significant predictors of outcome. Tracheostomy was a predictor of better outcome if done in patients, while increased duration of stay in ICU also leads to improved outcome.

Recommendation

The mechanical ventilation is the most common organ support therapy used in an ICU setting but still various factors associated with the outcome are poorly studied in our country. So we recommend that there is need of more such study as ours from various regions of India. Secondly we recommend use of scores and other predictor for predicting the outcome as they allow judicious use of resources.

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