ORIGINAL ARTICLE

# Identifying and Assessing the Factors Associated with Adverse Outcomes in Patients Requiring Mechanical Ventilation: Dire Need of the Hour

**Kuthe S[1], Humaney N[2], Mundle RP[3], Patni M[4]**

1. Assistant Professor, Department of Medicine, NKP Salve Institute of Medical Sciences & Lata Mangeshkar Hospital
2. Professor and Head, Department of Medicine, NKP Salve Institute of Medical Sciences & Lata Mangeshkar Hospital
3. Professor, Department of Medicine, NKP Salve Institute of Medical Sciences & Lata Mangeshkar Hospital, Nagpur
4. Junior resident, Department of Medicine, NKP Salve Institute of Medical Sciences & Lata Mangeshkar Hospital, Nagpur

## Abstract

***Introduction:*** *Mechanical ventilation (MV) is a breakthrough in intensive care, and can be defined as an artificial way to ventilate patients who are unable to breathe spontaneously, reducing the work of breathing. The data shows that 41% of patients admitted to the Medicine intensive care unit needed mechanical ventilation for various medical conditions.* ***AIMS & Objectives:*** *The present study was undertaken to analyze the outcome of patients on invasive ventilatory support and to determine various factors influencing the outcome in patients on invasive ventilatory support.* ***Materials & Methods:*** *The present study is record based, retrospective study, with a sample size of 80. Study was carried out at rural tertiary health care centre of central India.* ***Results:*** *Statistically significant mortality was found in advancing age groups, ≥ 2 abnormal laboratory tests, ≥ 2 organ systems affected, increased duration of ventilatory support. No significant difference was found with regards to sex.* ***Conclusion:*** *It is very important to highlight and keep in mind that mechanical ventilation is a double edged sword; it may also increase mortality due to various complications, on the other hand it serves as lifesaving intervention.*

***Keywords****: Mechanical ventilation, ICU, patient outcomes.*

**Address for correspondence:** Dr. S. Kuthe. Assistant Professor, Department of Medicine, NKP Salve Institute of Medical Sciences and Lata Mangeshkar Hospital, Hingna Road, Digdoh Hills, Nagpur, (MS), India. **E-MAIL:** shilpatulankarkuthe@yahoo.com Phone no: +917722006412

Received on: 17/02/2017 Revised: 21/02/2017 Accepted : 25/02/2017

## Introduction

Recent data suggests that, major bulk of patients admitted to Intensive Care Unit (ICU) suffer from acute respiratory failure, which also happens to be the most frequently encountered organ dysfunction.[1] Under such status quo, life supporting intercessions are available in the form of mechanical ventilation, which may be invasive or non-invasive.[2] Mechanical ventilation (MV) is a breakthrough in intensive care, and can be defined as an artificial way to ventilate patients who are unable to breathe spontaneously, reducing the work of breathing.[3, 4] The data shows that 41% of patients admitted to the medicine ICU (MICU) needed mechanical ventilation for various medical conditions. Various studies have shown that the outcome of those not requiring ventilator support was significantly better than those requiring ventilator support- mortality 1.7% compared with 71.5% ($p<0.001$) with higher percentage of mortality in invasive ventilation as compared to non-invasive ventilation. Patients requiring invasive ventilator support are seriously ill and outcome is determined not by ventilator care alone, but also by underlying illness and other co-morbidities. Performance measures and outcome depends on implementation of universal practices and various scoring systems (APACHE II, SAPS etc.).[5] In semi-government or government

setups, where healthcare facilities are provided at accessible cost, implementation of such scoring systems can be tedious with undue financial burden. However, there is paucity of data regarding various factors influencing the outcome of patients on invasive mechanical ventilation. The present study will determine various relevant facts, factors influencing the outcome in invasively ventilated patients and will help to develop future strategies for better outcome and thus reducing financial burden. Epidemiological attributes of mechanically ventilated patients have outlooks, not only in clinical decision making, but also in designing policies for effective healthcare delivery.[6] Nevertheless, such studies are mostly archaic and done prior to the pervasive solicitation of assisted ventilation.[7, 8, 9] Thus the current study carries weightage since it will highlight data pertaining to factors affecting outcomes in patients on MV. This is done in pursuit of identifying such factors that complicate prognosis in patients on MV, so that appropriate policies can be designed, including steps to rectify such fallacies and implement them; also contributing to physician's knowledge about factors affecting outcome in patients on MV.

**Aims and Objectives:** The present study was undertaken to-

1. Analyze the outcome of patients on invasive ventilator support.
2. Determine various factors influencing the outcome in patients on invasive ventilatory support.

## Materials & Methods

1. Type of study: Observational retrospective record based study.
2. Study site: NKP Salve Institute of Medical Sciences & Lata Mangeshkar Hospital, Nagpur (M.S.).
3. Sample size: 80 (n).
4. Study participants:
   i. Inclusion criteria:
      - All patients admitted to Medicine ICU who required ventilatory support, irrespective of sex.

   ii. Exclusion criteria:
      - Patients who had taken discharge against request (DAMA),
      - Patients who opted for discharge on request (DOR) while patient still on ventilator,
      - Patients whose case record form had incomplete information.
5. Study duration: Two years (from January 2013 to December 2014).
6. Parameters recorded from medical records of patients:
   - Demographic profile.
   - Presenting complaints.
   - Diagnosis- grouped according to system affected.
   - Indication/s for mechanical ventilation.
   - Performance and outcome of patients.
7. Data entry: All the relevant data was entered into pre-designed format.
8. Ethical approval: Taken prior to the start of the study from Institutional Ethics Committee (IEC).
9. Written informed consent: not required as this was retrospective study and names were kept strictly confidential and the process was double blinded.
10. Statistical analysis: Chi square test was applied to find out the significant difference amongst variables was used to describe the strength of association. Fisher exact test was applied where one of the cells have values less than 5 or zero. P value of less than 0.05 was considered statistically significant and <0.01 was considered as statistically highly significant.

## Results

Out of the total 80 case files studied, 45 were male and 35 were female, out of which 33 patients died and 12 survived amongst males, while 26 females died and 9 survived. There was no statistically significant difference in mortality rate amongst both sexes with p-value>0.05. The patients were divided into various age groups. 18-30 years group had 12 patients, out of which 4 survived and 8 died; 31 to 40 years group had 12 patients, out of which out of which 4 survived and 8 died; 41 to 50 years age group had 19 patients, out of which 5 survived and 14 died; 51 to 60 years age group had 12 patients, out of which out of which 4 survived and 8 died; 61 to 70 years age group

had 16 patients, out of which 4 survived and 12 patients died; >71 years age group had 9 patients, out of which 1 survived and 8 patients died Mortality increased with advanced age which was statistically significant in age group 61 to 70 years and highly statistically significant in age group > 71 years with p <0.001 (Table 1).

**FIGURE 1: Outcomes in patients requiring ventilatory support & duration of ventilatory support.**

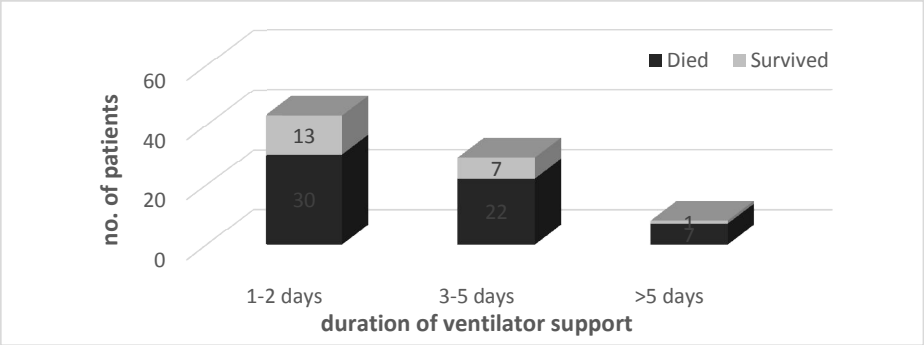


**TABLE 1: showing outcome of patients on mechanical ventilation with demographic details.**

| Demographic variable | | Death | Survived | Total | P value |
|---|---|---|---|---|---|
| Age | 20-30 yr | 8 | 4 | 12 | 0.06 |
| | 31-40 | 8 | 4 | 12 | 0.06 |
| | 41-50 | 14 | 5 | 19 | 0.07 |
| | 51-60 | 8 | 4 | 12 | 0.06 |
| | 61-70 | 12 | 4 | 16 | 0.05 |
| | >71 | 8 | 1 | 9 | 0.02 |
| Sex | Male | 33 | 12 | 45 | 0.54 |
| | Female | 26 | 9 | 35 | 0.47 |

p- value <0.05 is considered as statistically significant
p- value <0.01 is considered as highly statistically significant.

**TABLE 2: showing diagnosis wise outcomes in patients requiring ventilatory support.**

| Sr. No. | System affected (Diagnosis) | Death | Survived | Total | P-value |
|---|---|---|---|---|---|
| **1** | CVS (CAD, HTN, shock) | 7 | 3 | 10 | 0.06 |
| **2** | RS (Pneumonia, ARDS, COPD) | 13 | 2 | 15 | <0.05 |
| **3** | Renal (renal failure) | 2 | 7 | 9 | >0.05 |
| **4** | Hepato-biliary (alcoholic liver disease) | 4 | 3 | 7 | >0.05 |
| **5** | DKA | 2 | 0 | 2 | 0 |
| **6** | CNS (stroke, meningitis, seizures) | 2 | 3 | 5 | >0.05 |
| **7** | Others (OP poisoning, sepsis) | 5 | 1 | 6 | <0.05 |
| **8** | ≥ 2 systems affected | 24 | 2 | 26 | <0.01 |

Where, CVS- Cardiovascular system, RS- respiratory system, DKA- Diabetic ketoacidosis, CNS- Central nervous system, OP- Organophosphate.

**TABLE 3: showing laboratory test wise outcome of patients on ventilatory support.**

| Sr. No. | Abnormal Lab test | Died | Survived | Total | p-value |
|---|---|---|---|---|---|
| **1** | only CBC | 1 | 14 | 15 | >0.05 |
| **2** | only KFT | 3 | 2 | 5 | |
| **3** | only LFT | 1 | 2 | 3 | |
| **4** | only ABG | 16 | 1 | 17 | <0.05 |
| **5** | ≥ 2 tests | 38 | 2 | 40 | <0.01 |

Where, CBC- Complete blood count, KFT- Kidney function test, LFT- Liver function test, ABG- Arterial blood gas.

**TABLE 4: showing outcomes of patients and duration of ventilatory support.**

| Sr. No. | Duration of ventilatory support | Died | Survived | Total | p-value |
|---|---|---|---|---|---|
| **1** | 1-2 days | 30 | 13 | 43 | <0.05 |
| **2** | 3-5 days | 22 | 7 | 29 | <0.05 |
| **3** | >5 days | 7 | 1 | 8 | <0.01 |

Diagnosis-wise patients were divided into major system affected. Cardiovascular system (hypertension, MI, heart failure)- 10 patients, out of which 3 patients survived and 7 died; respiratory system (pneumonia, ARDS, COPD)- 15, out of which 2 patients survived and 13 succumbed to death; renal system (renal failure) - 9 patients, out of which 7 survived and 2 died; hepato-biliary system (alcoholic liver disease, cirrhosis)- 7 patients, out of which 3 survived and 4 died; diabetic ketoacidosis- 2 patients, both succumbed to death; central nervous system (stroke, meningitis, encephalitis)- 5 patients, out of which 3 survived and 2 died; others (poisoning, sepsis) - 6 patients, out of which 1 survived and 5 died; ≥2 systems affected-26 patients, out of which 2 survived and 24 died; this was statistically significant in respiratory system group, highly significant in diabetic ketoacidosis and ≥2 systems affected group ( $p<0.01$). Amongst diagnostic lab workup 15 patients were encountered with the only abnormal parameter being complete blood count (CBC), 3 had only abnormal liver function test (LFT), 5 had abnormal kidney function test, 17 had abnormal arterial blood gas test (ABG), out of which 16 died and only 1 survived, 40 patients had ≥2 abnormal laboratory tests, out of which 2 patients survived and 38 died, out of which abnormal ABG and ≥2 abnormal tests groups showed highly statistically significant association (Table 3). Amongst number of days on ventilator, maximum of 43 patients were on ventilator for 1-2 days, out of which 13 survived and 30 died; 29 patients were on ventilator for 3-5 days, out of which 7 patients survived and 22 died; 8 patients were on ventilator for >5 days, out of which only 1 patient survived and 7 patients died. Mortality rates increased with increased number of days on ventilator, which was statistically significant, highest significance in patients on ventilatory support for > 5 days (Table 4, Figure 1).

## Discussion

In the present study, males predominated as compared to females and similar results were found in other studies.[10,11, 12] There was no statistically significant difference found in mortality rates amongst male and females on ventilatory support. This may be due to the fact that, due to increasing awareness campaigns and outreach facilities at the present hospital prompted all patients to go to hospital, irrespective of sex. Similar findings were found in study done by Sodhi et al.[13] Mortality was more in age group >71 years as compared to other age groups, which was in contrast to findings reported by other study.[14] This may be due to the fact that present study was done in rural setting, where level of nutrition, socio-economic factors hamper effective healthcare, despite various efforts of healthcare providers to provide healthcare to all. In the present study most common diagnosis encountered was pneumonia, followed by myocardial infarction, stroke. These findings corroborated with that of other such studies done elsewhere.[12, 15, 16] However in one study most common diagnosis encountered was neurological.[13] Mortality was significantly higher in patients with more than or equal to two organ systems involvement. This is supported by the fact that such patients are at higher risk of multi organ failure, which carried worse prognosis. Moreover, such diseases in combination mostly lead to respiratory failure, which necessitates use of mechanical ventilatory support, thus initiating a vicious circle.[17] Momentous number of patients were encountered with renal failure also. However mortality was less as compared to that reported by other studies [18, 19] which concluded that end stage renal disease increased mortality. Patients with ≥2 abnormal laboratory tests had significantly higher mortality rate. After exhaustive literature search, we found no study which focused on laboratory tests and mortality in depth. So, the present can be considered as first of its kind to do so. Most important

predictor of mortality as revealed in many studies is duration a patient is on ventilatory support. In the present study highly significant mortality was found in patients who needed ventilatory support for >5 days. Such findings are corroborated with findings of other such studies.[14, 18] Despite many advances in mechanical ventilation mortality has not decreased in amounts, it should have decreased. This calls for extensive studies of all direct and indirect predictors of outcome in patients requiring ventilatory support, so that fallacies in delivery of healthcare can be identified and addressed accordingly.

## Conclusion

It is very important to highlight and keep in mind that mechanical ventilation is a double edged sword; it may also increase mortality due to various complications and predisposing factors, on the other hand it serves as lifesaving intervention.

***Conflict of Interest:*** *None declared*
***Source of Support:*** *Nil*
***Ethical Permission:*** *Obtained*

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