

SHORT-TERM OUTCOMES IN PATIENTS UNDERGOING MECHANICAL VENTILATION IN A TERTIARY CARE CENTRE IN SIALKOT

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ABSTRACT

Objectives: To determine the short-term mortality rate of patients on mechanical ventilation in a tertiary care center in Sialkot, Pakistan.

Study Design: Descriptive cross sectional study.

Place and Duration of Study: This study was conducted jointly by the departments of Anesthesiology, Surgery and Gynecology & Obstetrics at Combined Military Hospital Sialkot Cantonment, from Jul 2013 to Jun 2015.

Material and Methods: A total of 112 patients placed on mechanical ventilation were included in this study. The patients' age, gender, disease on admission, duration of ventilation, indication for ventilation, outcomes and complications were noted. SPSS 21 was used for data analysis.

Results: Fifty-eight (51.78%) patients expired while 54 (48.21%) were weaned off successfully. In the former group of expired patients, the major factors contributing towards the mortality were multi-organ failure (37.9%), VAP/ventilator-associated pneumonia (32.7%), coagulopathy (29.3%) and sepsis (27.5%). However, in the survivor patients group 5 patient (9.25%) developed VAP, 3 (5.55%) developed pneumothorax while 3 others (5.55%) developed a fever of unknown etiology.

Conclusion: The short-term mortality rate of patients who receive mechanical ventilation in an intensive care unit (ICU) in Sialkot, Pakistan is significantly higher than that of developed countries.

Keywords: Critical Care, Developing countries, Pneumonia, Respiratory distress syndrome, Ventilator-associated pneumonia.

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INTRODUCTION

Due to the vicissitudes in disease patterns and treatments, the needs of the patients are also changing. Thus, a judicious and prompt ventilation strategy is important for managing acute conditions and regulating the natural fluctuations of chronic disorders¹. Mechanical ventilation is the most commonly used short-term life support technique worldwide and is applied daily for a diverse spectrum of indications, from scheduled surgical procedures to acute organ failure. It has undergone significant evolution ever since its conception in the biblical era. Mankind has seen four generations of mechanical ventilators and is expected to witness 'smart' ventilators soon in the future. These 'smart' ventilators are predicted to be able

to integrate electronically with other bedside technology, effectively ventilate all patients in all settings, and carry closed-loop control on most aspects of ventilatory support, among other things². A large part of this existent and expected progression can be attributed to continued research. In fact, multiple randomized trials have advanced mechanical ventilation practices internationally. Considering the gravity and the complexity of the clinical conditions of the patients requiring mechanical ventilation, it is associated with established complications and even fatal sequelae. Thus, anything other than multimodality treatment and prevention strategies are destined to poor outcomes. Surprisingly, the prolonged ventilation in an intensive care setting is a limited resource and supports only a single organ i.e. lung, while it cannot cater for any other disease process. Successful mechanical ventilation requires a basic understanding of respiratory physiology and

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ventilator mechanics in addition to intensive nursing care. These critical patients on mechanical ventilation, require team work, knowledge of caregoals, and interventions based on best practices, patient needs, and response to therapy. Mechanical ventilation has become a common treatment, and nurses must be well-informed, versant, knowledgeable and confident when caring for ventilatorpatients.

As compared to developed countries like the United States, there is limited data about the success of ventilatory support from third-world countries like Pakistan. The little data that is available from Pakistan has been gathered from researches in top-notch hospitals in the largest cities of the country^{3,4}. However, there are no studies from satellite towns, regardless of their contribution to the country's economy or history.

mechanical ventilators available for use in the intensive care unit (ICU) which is looked after by the consultant anaesthesiologist. Unfortunately, the city lacks functional ventilators in all other health care centers, leaving the entire population of the Sialkot district, which includes the victims of cross-border shelling among other regular patients, dependent on the aforementioned ventilators if need be. Having established the worth of this center as the only source of mechanical ventilation for a geographically and economically important city like Sialkot, an audit was conducted to determine the short-term mortality rate in patients undergoing mechanical ventilation in CMH Sialkot.

MATERIAL AND METHODS

In this descriptive study, the medical records of patients who underwent mechanical venti-

Table-I: Indications for Mechanical Ventilation (n=112).

S. No.	Indications	n (%)	
1	Surgical Causes	Post-operative prophylaxis	15(13.3)
		Inadequate post-operative recovery	2 (1.7)
		Severe head injury	4 (3.57)
		Flail chest	1 (0.89)
2	Medical Causes	Apnea/ Impending respiratory arrest	14(12.5)
		Acute exacerbation of COPD	21 (18.7)
		Acute severe asthma	7 (6.25)
		Acute hypoxemic respiratory failure	9 (8.03)
		Heart failure/ Cardiogenic shock	1(12.5)
		Hypotension	7 (6.25)
		Neuromuscular disease	1 (0.89)
		Pulmonary edema	8 (7.14)
		Status epilepticus/ seizures	5 (4.46)
		No clear indication	4 (3.57)

Sialkot is one such town. On account of being bordered by India, its geographical importance stems from witnessing major Indo-Pak wars in the past and currently, from the cross-border shelling that has yet again become a regular happening. The casualties of these skirmishes are catered to at the Combined Military Hospital (CMH), Sialkot. The 1998 consensus, which is the latest one in Pakistan to date, disclosed the population of Sialkot to be 421,502. CMH Sialkot is a 600-bedded tertiary-care hospital with four

lation in CMH Sialkot were retrospectively reviewed. A total of 156 patients underwent mechanical ventilation during the allocated study period of July 2013 to June 2015. However, the medical records of only 116 patients could be retrieved due to unavailability of the rest. All the patients placed on the mechanical ventilation were included in this study irrespective of their age or the duration of ventilation. The variables noted down were age, gender, disease on admission, duration of ventilation, indication for

ventilation, outcomes and complications. Since this study primarily focuses on mortality, outcomes were divided into 3 groups; weaned off, expired and declared brain dead. When calculating mortality, the latter two groups were merged into one. The data were analyzed using SPSS 21. Descriptive statistics were used to summarize the data. Frequencies and percentages were calculated for outcomes and complications. Mean and standard deviation were calculated for numerical data which included age.

RESULTS

A total of 116 patients were included in the review of which four were excluded from the analysis on account of unknown outcomes due to being discharged or referred to higher centers on portable ventilators. Among the 112 that ended up being part of the calculations, 59 (52.7%) were females and 53 (47.3%) were males. The mean age was 38.6 ± 19.37 years with the youngest patient being 4 months and the oldest 85 years old. The patients stayed on ventilatory support for a mean time period of 3.52 days. The shortest period a patient on mechanical ventilation was 30 minutes, with the longest being 51 days. The majority of patients placed on mechanical ventilator were due to medical reasons (80.3%), mostly due to acute exacerbation of COPD, heart failure, apnea/ impending respiratory arrest and acute hypoxemic respiratory failure. Amongst the surgical cases (19.6%) mostly were the ones after surgical intervention either prophylactically placed on ventilator or due to poor recovery from anaesthesia. (table-I). Out of the 112 patients, 50 (44.64%) expired during the course of mechanical ventilation and 8 (7.14%) were taken off ventilatory support, with surrogate consent, on account of being declared brain dead. This led to a cumulative percentage of 51.78%, making that the short-term mortality rate. Fifty-four (48.21%) patients were weaned off ventilation successfully (figure). Amongst the patients who were weaned off successfully, 5 patients (9.25%) developed ventilator-associated pneumonia (VAP), 3 (5.55%) developed pneumo-thorax while 3 others (5.55%) developed a fever of unknown etiolog (table-II).

In the group of expired patients, the major factors contributing towards the mortality were multi-organ failure (37.9%), VAP/ ventilator-associated pneumonia (32.7%), coagulopathy (29.3%) and sepsis (27.5%). In addition, cardiac complications (12.06%) and pneumothorax (12.06%) were also noted (table-III).

DISCUSSION

Mechanical ventilation is indeed a life-saving intervention. However, it is associated with serious complications, partly because it is provided to patients at high risk of lung or cardiac compromise. These complications may be related to the direct mechanical effects of the intrathoracic pressures generated by the ventilator, to alveolar and systemic inflamma-

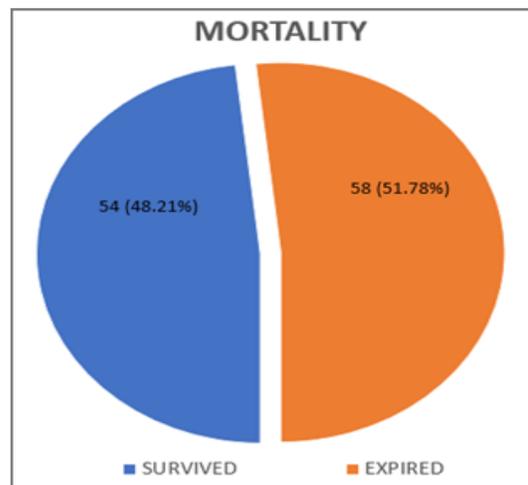


Figure: The short-term outcome of mechanical ventilation.

tion, or to neural stimulation⁵. The mechanical ventilation also effects the suggested cross-talk between the lung and the brain and between the lung and the kidneys^{6,7}. Many of the complications can potentially be evaded or minimized. This study showed that the short-term mortality rate for patients on mechanical ventilation was 51.78%. One of the purposes of this study was to compare the outcomes of mechanical ventilation in an ICU in Sialkot, as part of the developing world, with those of ICUs in developed countries. In 2013 Esteban *et al*⁸ reported that the crude mortality rate for mechanically ventilated patients was 31% in 1998 and it declined further

to 28% in 2010 with the overall improvement in management of these critically ill patients. The implementation of different integrated management strategies for precipitating conditions, such as sepsis⁹ protocols related to ventilator management, including sedation¹⁰ and incorporating extensive care to prevent nosocomial infections¹¹ possibly contributed to these findings. However, despite of limited data from the developing world, a few similar studies had comparable results. In a study conducted in Tamilnadu India, Sudarsanam *et al*¹² in 2005 reported a 71.5% short-term mortality rate for patients on mechanical ventilation. Likewise, in a local study from Pakistan, Khan *et al*³ explored ventilator outcomes back in 1998 and reported a

work in the developing world. This calls for measures to rule out the reasons for disparity. There are various factors that determine the outcome of mechanical ventilation. Among them, the factor that emerges repeatedly in research is the patient's underlying diagnosis and physiological status at the initiation of mechanical ventilation. Clinical scoring systems like sequential organ failure Assessment score (SOFA) score and acute physiology and chronic health evaluation (APACHE) II have also been observed to foretell ventilator outcomes¹³. Other predictors of mortality include pCO₂ levels and serum markers like CRP. Unfortunately, due to lack of recorded data, this retrospective study did not allow any room for these determinants to be

Table-II: complications in survivor group (n-54).

S. No.	Complications	n (%)
1	Ventilator associated pneumonia	5 (9.25)
2	Pneumothorax	3 (5.55)
3	Fever of unknown etiology	3 (5.55)

Table-III: Complications contributing to death in the expired patients group (n-58).

S. No.	Complications	n (%)
1	Ventilator associated pneumonia	19 (32.7)
2	Pneumothorax	7 (12.06)
3	Multi-organ failure	22 (37.9)
4	Sepsis/septicemia	16 (27.5)
5	Coagulopathy	17 (29.3)
6	Cardiac complications	7 (12.06)
7	Underlying disease	6 (10.3)

mortality rate of 48%. In a tertiary care cardiac center in Rawalpindi, the outcomes of patients on ventilatory support in coronary care unit were reported by Siddiqui *et al*⁴ in 2015 and the mortality rate was found to be 70%. This high rate was primarily due to the fact that these patients who required intubation and ventilation in coronary care setting had underlying left ventricular dysfunction and in almost two thirds the ejection fraction was 40% or even less, which made them even difficult to wean and extubate. The fact that the short-term mortality rate in our center was 1.85 times that of the mentioned Western study conducted by Esteban *et al* (2013)⁸, exposes us to the reality of the need for further

validated for this region as well. Weaning off from the ventilator is also an important decision and can have an impact on the outcome as well. In a local study, Hayat *et al*¹⁴ highlighted that diaphragmatic excursion was a better modality in predicting the weaning failure or success as compared to the traditional volume-based weaning parameters. This was also supported by Umbrello *et al*¹⁵

Mechanical ventilation is associated with iatrogenic complications as well. These include intubation-associated trauma, acute lung injury, barotrauma and ventilator-associated pneumonia (VAP). Amongst these, the ventilator-associated pneumonia is the second most common noso-

comial infection in the intensive care unit (ICU) and the most common in mechanically ventilated patients^{16,17}. These patients have an increased risk of VAP due to the damage of their first line defenses associated with endotracheal intubation¹⁸. Kalanuria *et al*¹⁹ and Melsen *et al*²⁰ reported that VAP is estimated to occur in 9–27% of all mechanically ventilated patients, with the highest risk being early in the course of hospitalization. VAP is associated with a high morbidity, mortality and significant financial burden. Rafiq *et al*²¹ and Ishtiaq *et al*²² reported 33.5% and 28.6% mortality of VAP in two different tertiary care centers in Pakistan respectively. Rafiq *et al*²¹ also reported acinetobacter baumannii as the predominant pathogen while most of the isolates were multidrug resistant with limited available treatment options. In our study we had 24 (21.4%) cases of VAP with majority leading to a fatal outcome. Studies show that the approximate risk of developing barotrauma in patients on mechanical ventilation is 4%–15%, with a 14%–87% incidence of pneumothorax depending on duration and severity of acute respiratory distress syndrome (ARDS), and mode of ventilator for management²³. Patients with ARDS are at highest risk for barotrauma, while an intermediate risk is suspected in patients with Chronic Obstructive Pulmonary disease (COPD) and asthma²³. In our study, we experienced 10 (8.92%) cases of pneumothorax. This is the first ventilator-related study carried out in the Sialkot district. Moreover, there is limited data available regarding outcomes of mechanical ventilation as a whole. This establishes this study's importance as representative of data from a satellite town of a third-world country like Pakistan. The data also holds significance for physicians in terms of prognostic awareness. Another similar study was conducted in central india and reported by chiwhane A (2016)²⁴ that the mortality rate in patients necessitating mechanical ventilation from under-developed/ low-resource settings was high, unlike the global trend of success worldwide, suggesting an urgent need for significant improvement in protocols for intensive

care unit set up in these settings. This study also hypothesized that the causes of worse outcomes were, delayed presentation of patients, lack of resources, inadequate healthcare infrastructure and financial constraints. Infactthere is a dire need of identifying shortcomings in the health care system with regards to ventilator care. One of the major reasons of the difference in the mortality rates offered by these studies and Western data is that established ICUs in the developed world have better equipment, trained staff and a respiratory therapist for mechanical ventilation. ICUs in Pakistan are largely bereft of these. Another reason for the higher mortality could be delayed presentation with multi-organ dysfunction syndrome.

Improvement in outcomes can be brought about by organization of regular workshops for all health care personnel employed in the ICU. It is essential that all physicians and nurses be trained regarding the basic concepts and clinical workings of ventilator management. Critical care clinicians' decisions regarding mechanical ventilation and related treatments such as level of sedation might have more profound and far-reaching residual effects than has been previously recognized. These critical patients on mechanical ventilation do require early mobilization which should be introduced within 72 hours following the initiation of the support and in fact the physical therapy ought to be delivered 24 hours per day, in order to have better results, reducing the duration of ventilatory support and even possible mortality rates. Decades of research, progress, and clinical monitoring has led to an increased understanding of the physiology of mechanical ventilation. The basic philosophy changed when the aim of mechanical ventilation moved from stabilizing blood gas levels to minimalizing ventilator induced lung injury while maintaining satisfactory gas exchange. As this was a retrospective study and used only patients' past medical records, it could not uncover the long-term outcomes of patients who had undergone mechanical ventilation. We currently do not have any knowledge about our study

subjects' current existential or functional status. However, this study can serve as a pioneer for future prospective studies that do follow patients for a few months or years after discharge.

CONCLUSION

The short-term mortality rate of patients who received mechanical ventilation in an ICU in Sialkot, Pakistan is significantly higher than that of developed countries. There is a need for more research, preferably prospective studies, in order to rule out the exact cause for this disparity.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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