

Evaluating Outcome in Mechanically Ventilated Young Patients at a Pediatric Intensive Care Unit

MUHAMMAD JAMIL¹, IQBAL AHMED², ZAHID ANWAR³, WASEEM PASHA⁴, IBRAHIM⁵, USAMAH SAEED BUTT⁶

¹Assistant Professor, Department of Paediatrics, Shaihida Islam Teaching Hospital Lodhran.

²Associate Professor, Department of Paediatrics, Shaihida Islam Teaching Hospital Lodhran.

³Associate Professor of Paediatrics, Fatima Memorial Hospital Lahore.

⁴Assistant professor, Department of Paediatrics, CMH Kharian Medical college, Kharian Punjab

⁵Associate Professor, Paediatrics, Swat Medical College/Swat Medical Complex Teaching Hospital Saidu sharif Swat

⁶House Officer, Mayo Hospital Lahore / King Edward Medical University, Lahore, Pakistan

Corresponding author: Muhammad Jamil, Email: Dr.Jamil_168@Yahoo.com

ABSTRACT

Aim: To evaluate outcome in mechanically ventilated young patients at a pediatric intensive care unit.

Material and methods: This Study was conducted in the Department of Paediatrics, Shaihida Islam Teaching Hospital Lodhran in the duration from October, 2022 to March, 2023. We randomly sampled 154 pediatric ICU patients requiring mechanical breathing aged 1–10 years of both genders. The outcome of mechanically ventilated young patients at a pediatric intensive care unit was evaluated. Independent samples T test and Chi Square test were applied for assessing association keeping statistical significance at 0.05.

Results: The mean age of the patients was 4.44±2.61 years, length of hospital stay 7.08±4.27 days. In our study 102 (66.2%) patients survived while 52 (33.8%) had expired. Outcome had significant association with type of cases and length of hospital stay.

Conclusion: From our study we conclude that the expiry rate of the children admitted for mechanical ventilation was 33.8%.

Keywords: Mechanical ventilation, Pediatrics, Pediatric Intensive Care Unit, Critical illness.

INTRODUCTION

One of the most common reasons for admission to pediatric intensive care units (ICUs) is the need for mechanical ventilation (MV), which is often a lifesaving treatment¹. Nearly, 30% of patients have trouble weaning off MV, and such people have a greater mortality rate. Consequently, past research has analyzed the connections between the various weaning categories and the clinical outcomes². It is possible to prevent or reduce the severity of many MV problems³. Patients are at increased risk of respiratory and/or circulatory distress during endotracheal intubation⁴. Pre-oxygenation is crucial, and various methods have been proposed for individuals with the most severe condition, including noninvasive ventilation, and high flow administered through nasal cannula⁵.

Sedation either with/without paralysis is usually necessary in the initial stages of MV, especially for patients in shock or with acute respiratory distress syndrome⁶. The outcome may be affected by the sedative medicines used and the decisions made regarding their use⁷. The short half-life of propofol encourages its usage, although there are issues with infusions that last too long. Because it decreases delirium, dexmedetomidine may be a useful substitute for conventional sedation⁸. To prevent a patient from falling into a profound sedation state, it is crucial to keep a close eye on how sedated they are and to follow a sedation protocol that includes interrupting sedation on a daily basis⁹.

In wealthy countries with an established field of pediatric intensive care medicine, the proportion of children getting MV in PICUs varies between 17-64%¹⁰. Despite its vital function, MV is linked to undesirable outcomes and can cause issues including shock, VAP, pulmonary bleeding, pneumothorax, atelectasis, and pharmaceutical side effects (such sedatives and analgesics)^{10, 11}. Children who require mechanical ventilation have a mortality rate of 40-60%, according to numerous research conducted at LRIC. Patients who required mechanical ventilation had a death rate of 30.5%, and a complication rate of 9.4%, according to a study conducted in the Intensive Care Unit at Pakistan's Aga Khan University Hospital¹².

Better utilization of resources and clinical decisions for the few pediatric intensive care unit (PICU) facilities depends on patient characteristics and prognosis in patients requiring MV. But in our setting, this data on PICU MV is not handled appropriately. That is the reason, we set out to evaluate the long-term effects of mechanical ventilation on young children in our healthcare system.

MATERIAL AND METHODS

This observational study was conducted at the Department of Paediatrics, Shaihida Islam Teaching Hospital Lodhran in the duration from October, 2022 to March. We enrolled 154 critically ill patients admitted in Pediatric ICU presented for mechanical ventilation having age between 1 to 10 years of both genders through non probability consecutive sampling. Written consent form was signed by their parents/guardian to partake in the study. Demographic data like age, gender, indication for admission along with complications developed after MV, type of cases and outcome (survived or expired) were noted down on a predesigned pro-forma.

Sample size was calculated using WHO sample size calculator taking previous frequency of sepsis as an indication of admission 26.8¹³, margin of error 7% and confidence interval 95%.

Data was analyzed using IBM SPSS 20. Mean and standard deviation were used for numerical variables while we used frequencies and percentages for nominal and ordinal categorical variables. Independent samples T test was applied for association between outcome and numerical variables while Chi Square test was applied for categorical variables keeping statistical significance at <0.05.

RESULTS

This study was conducted on 154 patients. The mean age of the patients was 4.44±2.61 years. The length of hospital stay in our study was 7.08±4.27 days. Regarding gender distribution there were 100 (64.9%) male and 54 (35.1%) female patients in our study. Regarding the type of cases presented 122 (79.2%) medical cases and 32 (20.8%) surgical cases.

Regarding the indication for mechanical ventilation, respiratory failure was the leading indication 35.10%, followed by neurological 29.20%, cardiovascular indications were 14.90%, neurosurgical indications were 11.7% and sepsis was 9.10%.

The major complication we observed was ventilation associated pneumonia 16.90% followed by pneumothorax 7.80% and atelectasis was 5.8%. Majority of the patients did not developed any complications (69.5%). Regarding the outcome, in our study 102 (66.2%) patients survived while 52 (33.8%) had expired.

We observed a strong association between the outcome and type of cases, we observed that the surgical cases had higher rates of expiry as compared to the medical cases (P = 0.0001)

Longer hospital stay was significantly associated with the outcome, the longer duration at the hospital lead to higher rates of expiries (P = 0.001)

Table 1: Baseline characteristics

Characteristics		Statistics
Age (Years)		4.44±2.61
Length of hospital stay (Days)		7.08±4.27
Gender	Male	100 (64.9%)
	Female	54 (35.1%)
Type of cases	Medical	122 (79.2%)
	Surgical	32 (20.8%)

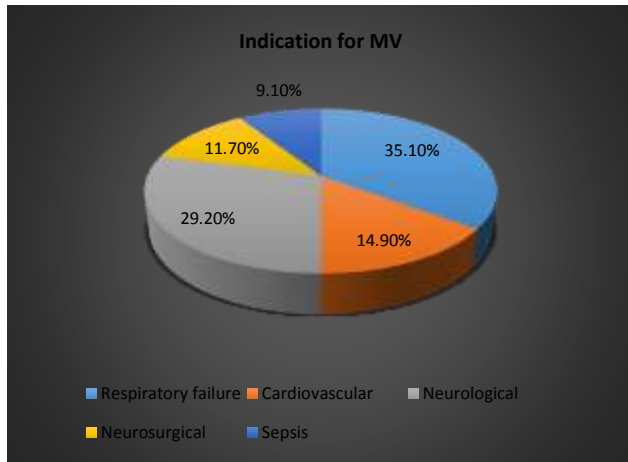


Figure 1: Indication for MV

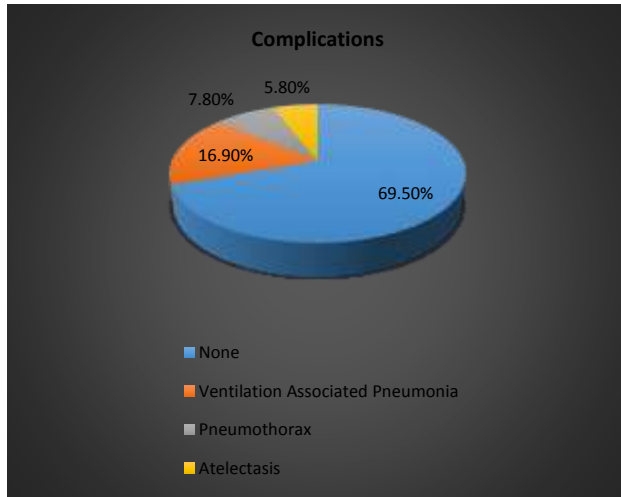


Figure 2: Complications

Table 2: Association of type of cases with outcome

Outcome	Survived	Type of cases		Total	P value
		Medical	Surgical		
Survived	90	12	102	0.0001	
	73.8%	37.5%	66.2%		
Expired	32	20	52	0.0001	
	26.2%	62.5%	33.8%		
Total	122	32	154	100.0%	
	100.0%	100.0%	100.0%		

Table 3: Association of length of hospital stay with outcome

Length of hospital stay (Days)	Outcome	N	Mean	Std. Deviation	P value
	Survived	102	6.27	3.761	
Expired	52	8.67	4.797		

DISCUSSION

In developed nations where pediatric intensive care medicine is an established medical specialty, the proportion of infants receiving MV in PICUs ranges from 17 to 64 percent. The prevalence of MV use among Egyptian minors was 32.8%. In a study it was reported that, 32 percent of the 16 pediatric ICUs had only one functional mechanical ventilator, 38 percent had two, and the remaining units had between three and six.¹³

Despite its significance, mechanical ventilation (MV) is associated with poor outcomes and may result in complications such as shock, ventilator-associated pneumonia (VAP), pulmonary hemorrhage, pneumothorax, atelectasis, and adverse drug reactions (e.g. sedatives and analgesics). Numerous studies in LRIC have revealed that the mortality rate for mechanically ventilated children spans from 40 to 60%. In a study conducted at the PICU of Aga Khan University Hospital in Pakistan, the mortality rate among mechanically ventilated patients was found to be 30.5%, while the rate of complications was 9.4% (1). A report from Nepal indicated a mortality rate of 34.1%.¹⁴

Both ER and PICU are comparatively new concepts, and data regarding the status of PICU in different regions of Pakistan are limited. As the modern healthcare system evolves, there is a growing demand for critical care services and facilities. In a modern healthcare system, the PICU is an integral part of children's hospitals and a reflection of the quality of pediatric medical treatment in the country. The pediatric intensive care services have demonstrated positive effects on the survival of children with potentially fatal illnesses. A PICU has multiple admission sources, including the operating room, emergency room, wards, and transfers from other institutions. The percentage of patients admitted to the PICU from the ER ranged from 20% to 68% in a few pediatric reports.¹⁴

We conducted this study on 154 patients admitted at pediatric ICU. Mean age of the patients was 4.44±2.61 years. Majority patients were from male gender 64.9%. We observed that most of the cases presented for mechanical ventilation were medical cases 79.2% and only 20.8% were surgical, similar findings have been reported by a study which showed that majority of their presenting cases were medical.¹³

The outcome in our study was survival and expiry of the patients who were admitted for mechanical ventilation, in our study 102 (66.2%) patients survived while 52 (33.8%) had expired. A study conducted in Pakistan reported that the mortality rate in their findings was 20.3%.¹⁴ However the aforementioned study concluded that their mortality rate was higher than 50%.¹³ The length of hospital stay in our study was 7.08±4.27 days, several studies have reported that the mean length of hospital stay was 3.1, 4.5 and 5 days.^{15,16,17}

Respiratory failure was the leading cause of admission for mechanical ventilation which accounted for 35.10% of the patients, neurological indication was 29.2% and cardiovascular indication accounted for 14.90% in medical cases. In surgical cases neurosurgical indication accounted for 11.7% cases followed by sepsis 9.10%. The aforementioned Pakistani study also reported similar findings however in their study neurological illness was the leading cause for admission.¹⁴

Complications found in our study were ventilation associated pneumonia, pneumothorax and atelectasis, among these complications ventilation associated pneumonia was the most frequent complication which is also reported by various studies^{18,19}.

CONCLUSION

From our study we conclude that the expiry rate of the children admitted for mechanical ventilation was 33.8%, we found a significant association between expiry rate with surgical cases and longer duration of hospital stay.

REFERENCES

1. Kneyber MC, De Luca D, Calderini E, Jarreau PH, Javouhey E, Lopez-Herce J, et al. Recommendations for mechanical ventilation of

- critically ill children from the Paediatric Mechanical Ventilation Consensus Conference. *Intensive Care Med.* 2017;43:1764-80.
2. CHOI, A. Y. et al. Outcomes of mechanical ventilation according to WIND classification in pediatric patients. *Ann Intensive Care.* 2019;9(1):72-75.
 3. Yoshida T, Fujino Y, Amato MB, Kavanagh BP. Fifty years of research in ARDS. Spontaneous breathing during mechanical ventilation. Risks, mechanisms, and management. *Am J Respir Crit Care Med.* 2017;195(8):985-92.
 4. De Jong A, Molinari N, Terzi N, Mongardon N, Arnal JM, Guitton C, et al. Early identification of patients at risk for difficult intubation in the intensive care unit: development and validation of the MACOCHA score in a multicenter cohort study. *Am J Respir Crit Care Med.* 2013;187(8):832-39.
 5. Brown III CA, Bair AE, Pallin DJ, Walls RM, Near III Investigators. Techniques, success, and adverse events of emergency department adult intubations. *Ann Emerg Med.* 2015;65(4):363-70.
 6. Long L, Ren S, Gong Y, Zhao H, He C, Shen L, et al. Different depths of sedation versus risk of delirium in adult mechanically ventilated patients: A systematic review and meta-analysis. *PLoS One.* 2020;15(7):e0236014.
 7. Porhomayon J, El-Solh AA, Adlparvar G, Jaoude P, Nader ND. Impact of sedation on cognitive function in mechanically ventilated patients. *Lung.* 2016;194(7):43-52.
 8. Djaiani G, Silverton N, Fedorko L, Carroll J, Styra R, Rao V, et al. Dexmedetomidine versus propofol sedation reduces delirium after cardiac surgery: a randomized controlled trial. *Anesthesiology.* 2016;124(2):362-68.
 9. Taran Z, Namadian M, Faghihzadeh S, Naghibi T. The effect of sedation protocol using Richmond Agitation-Sedation Scale (RASS) on some clinical outcomes of mechanically ventilated patients in intensive care units: a randomized clinical trial. *J Caring Sci.* 2019;8(4):199-205.
 10. Begum A, Shashikala V, Kumar CS. A prospective study on clinical profile and outcome of ventilated children in a pediatric intensive care unit of a tertiary care teaching hospital, Telangana. *J Appl Dent Med Sci.* 2016;15(4):13-17.
 11. Rimensberger PC, Cheifetz IM, Pediatric Acute Lung Injury Consensus Conference Group. Ventilatory support in children with pediatric acute respiratory distress syndrome: proceedings from the Pediatric Acute Lung Injury Consensus Conference. *Pediatr Crit Care Med.* 2015;16(5):51-60.
 12. Mukhtar B, Siddiqui NR, Haque A. Clinical characteristics and immediate-outcome of children mechanically ventilated in PICU of Pakistan. *Pak J Med Sci.* 2014;30(5):927-30.
 13. Tigist Bacha, Netsanet Tsegaye, Wagari Tuli. Characteristics and Outcomes of Mechanically Ventilated Pediatric Patients in Tikur Anbessa Specialized Referral Hospital, Addis Ababa, Ethiopia: Cross Sectional Study. *Ethiop J Health Sci.* 2021;31 (5):915.
 14. Haque A, Siddiqui NR, Jafri SK, Hoda M, Bano S, Mian A. Clinical profiles and outcomes of children admitted to the pediatric intensive care unit from the emergency department. *J Coll Physicians Surg Pak.* 2015;25(4):301-3.
 15. Principi T, Fraser DD, Morrison GC, Farsi SA, Carrelas JF, Maurice EA, Kornecki A. Complications of mechanical ventilation in the pediatric population. *Pediatr Pulmonol.* 2011;46(5):452-7.
 16. Wolfler A, Calderoni E, Ottonello G, Conti G, Baroncini S, Santuz P, Vitale P, Salvo I, SISPE Study Group Daily practice of mechanical ventilation in Italian pediatric intensive care units: a prospective survey. *Pediatr Crit Care Med.* 2011;12(2):141-146.
 17. Julio A, Farias AF, Ezequiel M, et al. Mechanical ventilation in pediatric intensive care units during the season for acute lower respiratory infection. *Pediatr Crit Care Med.* 2012;13(2):158-164.
 18. Meligy BS, Kamal S, El Sherbini SA. Mechanical ventilation practice in Egyptian pediatric intensive care units. *Electronic physician.* 2017;9(5):4370-77.
 19. Dr. Ayesha Begum DSV, Dr.C.Suresh Kumar. A Prospective Study on Clinical Profile and Outcome of Ventilated Children in A Pediatric Intensive Care Unit of a Tertiary Care Teaching Hospital, Telangana: *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)* Apr. 2016;15: 13-7.