



ORIGINAL ARTICLE

Outcome among mechanically ventilated children in a tertiary care hospital.

Murtaza Ali Gowa¹, Muhammad Usman², Syed Habib Ahmed³, Muhammad Shahzad⁴

Article Citation: Gowa MA, Usman M, Ahmed SH, Shahzad M. Outcome among mechanically ventilated children in a tertiary care hospital. Professional Med J 2022; 29(7):1035-1040. <https://doi.org/10.29309/TPMJ/2022.29.07.6227>

ABSTRACT... Objective: To determine the frequency of outcomes among children who are mechanically ventilated in PICU. **Study Design:** Prospective Observational study. **Setting:** National Institute of Child Health (NICH). **Period:** January 2020 to June 2020. **Material & Methods:** All children who fulfill the sample inclusion criteria were registered for research and prior consent was taken from parents or guardian by primary researcher. The primary investigator followed the patient till discharge from PICU. The patient information was obtained through medical record, patients' charts, and directly by following the patients prospectively. Data was analyzed by employing SPSS version 25. In the test, significance was determined by P value of less than 0.05. **Results:** Mean age of patients was 6.73 ± 3.90 years. There was 55.7% male and 44.3% female patients. Mean weight, duration of stay in PICU, mechanical ventilation days, PEEP, PIP, Pressure Support and FI_{O_2} was 21.92 ± 10.29 kg, 6.73 ± 5.46 days, 5.78 ± 4.43 days, 5.36 ± 0.55 , 16.87 ± 1.03 , 9.63 ± 0.78 and 55.05 ± 19.47 respectively. In our study, mortality rate was 37%. We found significant association of age group, cardiogenic shock and Sepsis with outcome. **Conclusion:** Mortality rate among mechanically ventilated patients was 37% while outcome was significantly associated with age group, cardiogenic shock and sepsis.

Key words: Mortality Rate, Mechanically Ventilated Children, Outcome, PICU.

INTRODUCTION

Mechanical Ventilation (MV) can be termed as a technological advancement that turns out to be a life support for many patients facing breathing issues as it cuts down the load of breathing. It can be listed among the most common reasons for which patients are admitted to an ICU, however with positive pressure MV is the most frequent procedure that has been used in the PICU.¹ MV is linked with short and long term complications that consist of pneumothorax, atelectasis, Ventilator Induced Lung Injury (VILI), Ventilator-associated Pneumonia (VAP), blockage of the tracheal tube in the intubating period and tracheal stenosis and tracheal edema after the extubating period. The prevalence of children and infants, who have been mechanically ventilated, range from 30% to 64% during different time period.²⁻⁵

Indications of MV are varied. Most common categorical indications include respiratory

causes (pneumonia, bronchiolitis, laryngotracheobronchiolitis, and pulmonary hemorrhage), cardiac arrest along with hypertension (heart failure, myocarditis), central nervous disease (neuromuscular disorder or coma), septic shock, and protection of air ways more importantly in situations such as sepsis. Since the introduction of MV in the modern ICUs, to improve the efficacy this method is go through continuous evolution. The discovery of new methods ventilator support necessitates researches, consideration of the epidemiology and outcome of the required application of the method MV. Hence, the array of new modes in the ventilation support, a lot of which have been included in the daily clinical practice with little evidence of their significance over the other ventilation modes employed. The reason for this is that in most of the cases, the doctors have to depend on just the short researches, that are carried out on a small sample of patients,

1. MBBS, FCPS, Post fellowship in PCCM, Assistant Professor PICU, National Institute of Child Health, Karachi.
2. MBBS, Resident Pediatric, National Institute of Child Health, Karachi.
3. FCPS (Peads), Assistant Professor Pediatric, National Institute of Child Health, Karachi.
4. MBBS, FCPS Fellow, Senior Registrar PICU, National Institute of Child Health, Karachi.

Correspondence Address:

Dr. Murtaza Ali Gowa
PICU,
National Institute of Child Health, Karachi.
murtazagova@gmail.com

Article received on: 23/11/2020
Accepted for publication: 15/12/2021

in order to decide on the mode of ventilator support they must utilize for the patients having acute respiratory failure. Therefore, only a few researchers have done remarkable work in this regard. In a study carried out by Harel and his coworkers, which put forward the outcomes of a survey carried out by mail in the United States.⁶ The survey was regarding the pediatric physicians in critical care units and it brought forward the findings that the first choice of most of the physicians in the mode of ventilation is synchronized intermittent mandatory ventilation (SIMV). Nevertheless, the main shortcoming of the survey conducted by mail is that it put forward the self-reported practices instead of the actual ones. MV is highly likely to be examined increasingly because of the greater emphasis on cost efficiency and bringing patient outcomes on paper, as it is a high-cost technology.⁷⁻⁹ The daily examination of the practices being carried out in the normal PICUs will surely increase the level of information readily accessible on utilization of different ventilator modes as well as the outcomes of the children and infants who are mechanically ventilated.

Kendirli T, et al reported that failure of respiration because of pneumonia can be regarded as the most prevalent reason for mechanical ventilation. The study has further revealed 58.3% as the rate of mortality while the rate at which complications in cases arise was 42.8%.⁵ Both studies showed that respiratory causes were the most common indication for ventilation. The percentage of mechanical ventilation varies from 30 to 64% in PICUs.²⁻⁴ Shaukat et al reported from Pakistan that 23.5% patients admitted to PICU needed mechanical ventilation. Major indications were infectious diseases (26.2%), CNS conditions (29.3%), and respiratory conditions (22.6%). The high mortality rate (63%) was associated with mechanically ventilated children.⁶ PICU is a newly growing subspecialty in pediatrics. Epidemiological studies regarding mechanical ventilation are scarce. The purpose of this research is to assess the frequency of outcome in the tertiary care hospital among the children who are mechanically ventilated.

MATERIAL & METHODS

The existing study was prospective observational study and it was carried out from January' 2019 to December' 2019 at PICU, National Institute of child health (NICH), Karachi after approval from ethical committee (IERB#58/2019). The size of the sample for the current study was determined by a software of WHO in which mortality was taken at PICU $P=16.3\%$ whereas the margin of error was kept at 5%. The calculated sample size was 210.

All PICU admitted children from 1 month to 14 years age who need mechanical ventilator for respiratory support were included in study. All the children who fulfill the sample inclusion standards were taken in the research and prior consent of their guardians or parents was taken by the researcher. The primary investigator followed the patient till discharge from PICU and relevant data was documented. The information regarding the patient was obtained through medical record, patients' charts, and directly following the patients prospectively. Data was collected through a structured questionnaire administered to all consented participants. The questionnaire was in English language and it was filled by the on duty doctor of PICU. The data include basic demography i.e. age, gender, weight, length of stay in PICU, primary disease, co morbidities; clinical variables (indications and ventilator parameters); and outcome (complications and discharge status). All the information retrieved was kept confidential.

Data was analyzed by utilizing SPSS version 25. Descriptive statistics was used as the method for analyzing quantitative and qualitative variables. Mean comparison was done by independent t-test. Fisher Exact test and Chi-Square test were applied to assess the relationship among the variables. In addition, cox regression was utilized for the purpose of observing the influence of several risk factors on survival. In the test, significance was determined by P value of less than 0.05.

RESULTS

The total sample of 210 patients was examined

for the existing research. Mean age of patients was 6.73 ± 3.90 years. There was 55.7% male and 44.3% female patients. Mean weight, duration of stay in PICU, mechanical ventilation days, PEEP, PIP, Pressure Support and FIO_2 was 21.92 ± 10.29 kg, 6.73 ± 5.46 days, 5.78 ± 4.43 days, 5.36 ± 0.55 , 16.87 ± 1.03 , 9.63 ± 0.78 and 55.05 ± 19.47 respectively as presented in Table-I. Out of 210 patients, 6.2% were found with post-operative complication, 42.9% with acute respiratory failure, 9.5% with cardiogenic shock, 29.5% with sepsis, 21.9% with CNS illness, 14.8% with ventilator associated Pneumonia, 1.9% with pneumothorax and 5.7% with accidental extubating as presented in Table-II. In our study, in hospital mortality was 37% as presented in Figure-1.

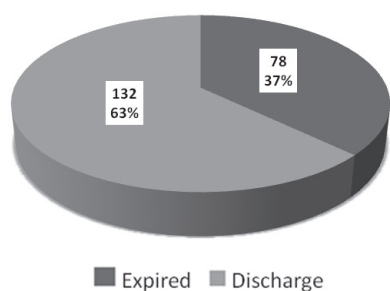


Figure-1. Frequency and percentage of outcome among population

We found significant association of age group ($p=0.011$), cardiogenic shock ($p=0.000$) and Sepsis ($p=0.000$) with in-hospital mortality as presented in Table-II. The study revealed that the male patients were on increased risk of mortality in comparison with female patients [(HR=1.340, 95% CI:0.843-2.131)]. Our results also shows that patients with post op complications are on

more risk as compared to those who haven't post op complication [(HR=1.927, 95% CI:0.759-4.894)]. Detailed hazard ratios by univariate and multivariate cox regression are presented in Table-III.

DISCUSSION

Data revealed that among 210 patients, on an average, 5.78 days a child was on mechanical ventilation. Another study showed that 50.7% (i.e. 307 out of 605) of children and infants who were given admission in the PICU under observation had undertaken MV for over 24 hours. In addition, the percentage of the mechanically ventilated patients in the pediatric division in different PICUs ranged from 14% to 60%^{2-4,8,9} Furthermore, it has been observed through the study of Vigayakumary et al. that around 52% of the total infants admitted in PICU were given MV in Sri Lanka.⁷ Similarly, it was stated in the study of Wolfler et al. that in Italy, around 34.6% to total children admitted in PICU required MV for a time period of more than 24 hours.⁴ Adding further to this discussion, it was reported through a cross-section study conducted in United States by Khemani et al. that around 30% of the total children admissions in PICU required MV.¹⁰

Moving on, it can be stated that the most frequent indication requiring mechanical ventilation in the current study was acute neurological illnesses as this illness occurred in 46.0% of the total cases. In comparison, Beenish et al¹ and Wolfler et al.⁴ also discovered neurological illness (35.6%) amongst the most occurring indication of MV in PICUs.

	Mean \pm SD			P-Value
	Overall (n=210)	Discharge (n=132)	Expired (78)	
Age(years)	6.73 ± 3.90	6.53 ± 3.54	7.06 ± 4.45	0.376
Weight(kg)	21.92 ± 10.29	21.42 ± 9.27	22.76 ± 11.83	0.396
Length of stay in PICU(Days)	6.73 ± 5.46	7.01 ± 5.69	6.26 ± 5.06	0.337
Mechanical Ventilation Days	5.78 ± 4.43	5.86 ± 4.45	5.65 ± 4.41	0.750
PEEP	5.36 ± 0.55	5.38 ± 0.59	5.32 ± 0.47	0.463
PIP	16.87 ± 1.03	16.92 ± 1.00	16.78 ± 1.07	0.335
Pressure Support	9.63 ± 0.78	9.70 ± 0.72	9.51 ± 0.86	0.098
FIO2 (%)	55.05 ± 19.47	54.55 ± 20.20	55.90 ± 18.26	0.628

Independent t-test was applied.

0.05 indicated significance level.

Table-I. Comparison of survival status according to quantitative characteristics of population

		Outcome			P-Value
		Discharge (n=132)	Expired (78)	Total (n=210)	
Gender	Male	77(58.3)	40(51.3)	117(55.7)	0.320
	Female	55(41.7)	38(48.7)	93(44.3)	
Age Groups	1-5 years	64(48.5)	37(47.4)	101(48.1)	0.011
	6-10 years	48(36.4)	17(21.8)	65(31)	
	> 10 years	20(15.2)	24(30.8)	44(21)	
Post-Operative Complication	Yes	8(6.1)	5(6.4)	13(6.2)	1.000 ^I
	No	124(93.9)	73(93.6)	197(93.8)	
Acute Respiratory Failure	Yes	60(45.5)	30(38.5)	90(42.9)	0.322
	No	72(54.5)	48(61.5)	120(57.1)	
Cardiogenic Shock	Yes	20(15.2)	0(0)	20(9.5)	0.000
	No	112(84.8)	78(100)	190(90.5)	
Sepsis	Yes	27(20.5)	35(44.9)	62(29.5)	0.000
	No	105(79.5)	43(55.1)	148(70.5)	
CNS Illness	Yes	33(25)	13(16.7)	48(21.9)	0.158
	No	99(75)	65(83.3)	164(78.1)	
Ventilator Associated Pneumonia	Yes	17(12.9)	14(17.9)	31(14.8)	0.317
	No	115(87.1)	64(82.1)	179(85.2)	
Pneumothorax	Yes	4(3)	0(0)	4(1.9)	0.299
	No	128(97)	78(100)	206(98.1)	
Accidental Extubation	Yes	8(6.1)	4(5.1)	12(5.7)	1.000
	No	124(93.9)	74(94.9)	198(94.3)	

Chi Square test was applied.

^I Fisher exact test was applied.

P≤0.05, considered as significant.

Table-II. Comparison of survival status according to qualitative characteristics of population

		Univariate		Multivariate	
		P-value	Hazard Ratio(95% CI)	P-value	Adjusted Hazard Ratio(95% CI)
Gender	Male	0.216	1.340(0.843-2.131)		
	Female [®]		1		
Age Groups	1-5 years	0.094	0.641(0.380-1.079)		
	6-10 years	0.009	0.431(0.228-0.814)		
	> 10 years [®]		1		
Post-Operative Complication	Yes	0.168	1.927(0.759-4.894)		
	No [®]		1		
Acute Respiratory Failure	Yes	0.044	0.618(0.387-0.988)	0.459	0.816(0.477-1.396)
	No [®]		1		1
Cardiogenic Shock	Yes	0.185	0.044(0.000-4.430)		
	No [®]		1		
Sepsis	Yes	0.002	2.018(1.282-3.176)	0.022	1.833(1.093-3.076)
	No [®]		1		1
CNS Illness	Yes	0.079	0.582(0.318-1.066)		
	No [®]		1		
Ventilator Associated Pneumonia	Yes	0.536	0.828(0.455-1.506)		
	No [®]		1		
Pneumothorax	Yes	0.748	0.048(NA)		
	No [®]		1		
Accidental Extubation	Yes	0.314	0.593(0.214-1.642)		
	No [®]		1		

[®]Reference group.

Univariate and multivariate Cox regression was applied.

P≤0.05, considered as significant.

Table-III. Hazard Ratio by Cox regression

Nevertheless, the literature has also revealed many other researches stating that respiratory illness that leads to failure in respiration can be termed as the most common reasons for which MV is administered in PICUs.^{2,10,11} In the current research, it was found that 42.8% of patient affected due to acute respiratory failure. This change in the trend can be easily explained by the utilization of ventilation with the help of Bi-PAP and high-flow nasal cannula during the starting stages of acute respiratory illness such as pneumonia and bronchiolitis, as respiratory supports provided in the initial phases.

We found significant association of age group cardiogenic shock and sepsis with outcome. It is found in studies that SIMV can be regarded as the mode of support in ventilation in initial stage because of the comfort, practice and confidence in this mode.^{11,12} In contrast, it has been observed that volume target ventilation has been increasingly administered in PICUs. These types of complications most comply occur in mechanical ventilation of PICU children.¹² In current study we also select the MV patient in PICU. In our study it is reported that Ventilator Associated Pneumonia (VAP) is 14.7% which is the main complication faced by the patient in our study. On the other hand, 9.2% was reported in a different study as the complication rate in comparison with the rate of complication of 42.8% as put forward by Kendirili et al and atelectasis was registered as the most prevalent complication.¹¹

The average time period for which mechanical ventilation was observed in the current research is 5.7 ± 4.4 days. In contrast to this, the time period of mechanical ventilation in some other studies was observed to be 4-6 days.^{2,3} Similarly, in the present study, the average duration of stay in PICU by patients was 6.7 days while in another study, the duration was reported to be more than 10 days in 6.2% of the cases.¹²

The aim of this research is to find out the indication of mechanically ventilated children in PICU. In our study acute respiratory failure and sepsis found significant association with outcome. On the other hand another study showed acute cardiac failure

and prolonged mechanical ventilation (>10days) as the main predictors of mortality in children in PICU who are mechanically ventilated.^{12,13}

In the present research, the mortality rate was found to be 37.1%. Among them 34.2% were male and 40.9% were female. The ratio of mortality among female is high in our study. The results also show that patients with post op complications are on more risk as compared to those who do not post op complication. Nevertheless, these reports show a complete different picture of the mortality rates among mechanically ventilated children.^{3,4,10} In addition to this, the studies of Kendiril et al. and Shaukat et al. have brought forward the findings that rate of survival was 58.3% and 63% in Turkey and Pakistan respectively.^{6,11} However, the study of Vigayakumary et al. has given findings that are close to the findings of the current research as mortality rate of 27.6% has been reported in this study among patients on mechanical ventilation. On the other hand, the overall rate of mortality in children being mechanically ventilated in PICUs was less than 2% in the developed nations.⁷

CONCLUSION

The findings of the study have revealed that 5.78 days was the average time during which the children were on ventilation. Additionally, it was found that 42.8% of patient affected due to acute respiratory failure. Similarly, it was revealed that Ventilator Associated Pneumonia (VAP) is 14.7% which is the main complication faced by the patients in current study. Finally, the findings of the current study exhibited that the mortality rate was 37.1%. The ratio of mortality among female is high in our study. Hence, it can be concluded that Mortality rate among mechanically ventilated patients was 37% while outcome was significantly associated with age group, cardiogenic shock and sepsis.




Copyright© 15 Dec, 2021.

REFERENCES

1. 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.

2. Mesiano G, Davis GM. **Ventilatory strategies in the neonatal and paediatric intensive care units.** Paediatr Respir Rev. 2008; 9(4):281-9.
3. Farias JA, Frutos F, Esteban A, et al., **What is the daily practice of mechanical ventilation in pediatric intensive care units? A multicenter study.** Intensive Care Med. 2004; 30(5):918-25.
4. Wolfler A, Calderoni E, Ottonello G, et al., **Daily practice of mechanical ventilation in Italian pediatric intensive care units: A prospective survey.** PediatrCrit Care Med Soc Criti Care Med. 2011; 12(2):141-6.
5. Roy KM, Miller MP, Schmidt K, Sagy M. **Pediatric residents experience a significant decline in their response capabilities to simulated life-threatening events as their training frequency in cardiopulmonary resuscitation decreases.** PediatrCrit Care Med. 2011; 12(3):e141-4.
6. Shaikat FM, Jaffari SA, Malik A. **Mechanical ventilation in children-a challenge.** Proceedings SZPGMI. 2000; 14(1):44-52.
7. Vijayakumary T, de Silva JR, Sarathchandra J, Kumarendran B. **Prospective study of ventilated patients in the paediatric medical intensive care unit of Lady Ridgeway Hospital.** Sri Lanka J Child Health. 2012; 41(3).
8. Rotta AT, Steinhorn DM. **Conventional mechanical ventilation in pediatrics.** Jornal de pediatria. 2007; 83(2):S100-8.
9. Farias JA, Fernández A, Monteverde E, Flores JC, Baltodano A, Menchaca A, Poterala R, Panico F, Johnson M, von Dessauer B, Donoso A. **Mechanical ventilation in pediatric intensive care units during the season for acute lower respiratory infection: A multicenter study.** PediatrCrit Care Med Soc Crit Care Med. 2012; 13(2):158-64.
10. Khemani RG, Markovitz BP, Curley MA. **Characteristics of children intubated and mechanically ventilated in 16 PICUs.** Chest. 2009; 136(3):765-71.
11. Kendirli T, Kavaz A, Yalaki Z, Ozturk-Hismi B, Derelli E, İnce E. **Mechanical ventilation in children.** Turkish JPediatr. 2006; 48(4):323.
12. Harel Y, Niranjana V, Evans BJ. **The current practice patterns of mechanical ventilation for respiratory failure in pediatric patients.** Heart & lung. 1998; 27(4):238-44.
13. Principi T, Fraser DD, Morrison GC, Farsi SA, Carrelas JF, Maurice EA, Kornecki A. **Complications of mechanical ventilation in the pediatric population.** Pediatrpulmonol. 2011; 46(5):452-7.

AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Murtaza Ali Gowa	Concept idea, Manuscript idea.	
2	Muhammad Usman	Data collection.	
3	Syed Habib Ahmed	Manuscript / Discussion writing.	
4	Muhammad Shahzad	Critical Review / Analysis.	