

Content available at: <https://www.ipinnovative.com/open-access-journals>

IP International Journal of Medical Paediatrics and Oncology

Journal homepage: <https://www.ijmpo.com/>

Original Research Article

Clinical profile of mechanically ventilated children aged 1 month to 18 years

Anil Bapurao Kurane¹, Indira Anil Kurane², Ashok Annasaheb Chougule¹,
Saiprasad Onkareshwar Kavthekar^{1,*}, Ashok Anandrao Patil³,
Hemant Pralhad Bharati¹

¹Dept. of Pediatrics, D.Y. Patil Medical College, D Y Patil Education Society (Deemed to be University), Kolhapur, Maharashtra, India

²Dept. of Physiology, D.Y. Patil Medical College, D Y Patil Education Society (Deemed to be University), Kolhapur, Maharashtra, India

³Ashirwad Clinic, PethVadgaon, Kolhapur, Maharashtra, India



ARTICLE INFO

Article history:

Received 13-04-2022

Accepted 30-05-2022

Available online 30-06-2022

Keywords:

Children

Mechanical Ventilation

Pediatric Intensive Care Unit

ABSTRACT

Background: Mechanical Ventilation (MV) is a life supporting device indicated in acute cardio-respiratory failure in children. A limited data is available about MV in children from India and our region too.

Aim: To study clinical profile of mechanically ventilated children aged 1 month to 18 years of age.

Materials and Methods: This retrospective study was conducted between 1st May 2014 to 30st April 2019 at Pediatric Intensive Care Unit (PICU) of D.Y.Patil Medical college and hospital, Kolhapur among 103 children who required MV. The medical records like PICU Register and case sheets were reviewed for details like age, gender, clinical diagnosis, comorbid conditions and indications, length, mode and complications of MV. The data was analyzed statistically.

Results: The incidence of MV was 13.08% (1348/103) and 54.37% patients were under-five age. The primary diagnosis was respiratory 42(40.78%), neurological 29(28.15%), and cardiac 10 (9.70%) illnesses. Pneumonia and status epilepticus were the commonest causes. The indications for MV were highest with respiratory failure 31(30.09%) and cardiorespiratory failure 23 (22.33%). The median duration of MV was 3 days. The stridor 20(19.42%) and endotracheal tube blockages 08(07.77%) were the commonest complications. The outcome of patients was improved in 60(58.25%) while death in 38(36.89%) patients. The highest deaths occurred in 9(23.68%), 8 (21.05%) patients with sepsis and pneumonia respectively.

Conclusions: The indication for MV was either respiratory or cardiorespiratory failure while respiratory (Pneumonia) and neurological (Status Epilepticus) were the commonest illnesses. Most of the patients were improved while deaths occurred mainly in sepsis and pneumonia patients.

This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

1. Introduction

Most of the critically ill children are managed in Pediatric Intensive Care unit (PICU) with the aim of achieving a better outcome¹ and around 20-64% require mechanical ventilation (MV) at some point during their PICU stay.^{2,3}

MV is a life supporting device to maintain the respiratory physiological function at the time of acute respiratory failure.^{4,5} Though MV has lifesaving benefits, it can result in several complications and adverse physiologic effects which may prolong the duration of MV itself, duration of hospitalization and may increase patient mortality.⁶

Also, many of the times, lots of errors can happen during MV and the possible reasons could be either due to scarcity

* Corresponding author.

E-mail address: saiprasadka@yahoo.co.in (S. O. Kavthekar).

of the resources, inexperienced doctors and nursing staff, lack of specific hospital protocols or severe disease itself which may prolong duration of MV. A lot of studies about MV in children are available from western world while very limited data from India. Also no studies are done from our region, Kolhapur where most of the patients come from surrounding rural area for critical care management. Hence this study was carried out with the aim of to study clinical profile of mechanically ventilated children aged 1 month to 18 years in PICU of D.Y.Patil Medical college and hospital, Kolhapur.

2. Materials and Methods

This retrospective study was conducted among 103 children aged 1 month to 18 years of age over the period of 5 years between 1st May 2014 to 30st April 2019. Ethical clearance was obtained from Institutional Ethics Committee (DYPMCK/247/2019/IEC). All children who were admitted in PICU of D.Y.Patil Medical college and hospital, Kolhapur and who required MV were included in this study. Surgical causes like operated congenital defects, head injury and road traffic accidents who required MV were excluded from this study.

The medical records like PICU Register and case sheet of mechanically ventilated children were reviewed after taking the permission from hospital authorities and was recorded in a standard proforma. It included the following information on demographic details like age and gender, date of admission, associated comorbid conditions, preliminary clinical diagnosis on the basis of presenting complaints, clinical signs and investigations, indications of intubation and mechanical ventilation, date of initiating ventilation, length of MV, mode of ventilation, complications of MV like laryngeal edema, ventilator associated pneumonia (VAP), atelectasis and pneumothorax, accidental extubation etc. and duration of hospital stay. VAP was defined as when ventilation greater than 48 hours with a new and persistent infiltrate, consolidation on chest radiograph and at least 3 of following: fever, leucopenia or leukocytosis, purulent sputum, rales, cough or worsening gas exchange.⁷ Atelectasis was identified by clinical and radiological examination while laryngeal edema was present if stridor occurred within 2 hours of extubation.⁸ The outcome of the child was also recorded as either extubated and improved, died on the ventilator or discharged against medical advice. The indications of intubation and MV were divided systematically as follows:

2.1. Central Nervous System

1. Neuromuscular diseases.
2. Glasgow Coma Score \leq 8/15.
3. Status Epilepticus.

2.2. Respiratory Causes

1. Apnea
2. Acute respiratory distress syndrome.
3. Impending respiratory failure.
4. Respiratory failure [severe refractory hypoxemia, PaO₂ < 60mmof Hg, hypercapnea PaCO₂> 50 mm of Hg].
5. Severe Acidosis pH< 7.25.
6. Airway maintenance.

2.3. Cardiac causes

1. Cardiorespiratory failure.
2. Congestive cardiac failure.

2.4. Miscellaneous causes

1. Sepsis.
2. Poisoning [Organo-phosphorous poisoning, Snake bite, scorpion sting].

The data was analyzed statistically by using Microsoft Excel 2010. The quantitative data was summerized as mean+ standard deviation (SD) and percentage. Chi square test was used for association where p value < 0.05 was taken as significant.

3. Results

A total 1348 patients were admitted to our PICU during the study period and among them 103 (13.08%) patients required MV. Out of 103 patients, 53 (51.46%) and 50 (48.54%) were males and females respectively with male : female ratio was 1:0.94. Fifty six (54.37%) patients were under-five age group who required MV. The age group variables who needed MV is shown in Table 1.

Table 1: Age group of patients who needed MV.

Age groups	Number of patients	Percentage (%)
1month-1year	26	25.24
>1year-5years	30	29.13
>5years-10years	20	19.42
>10years-15years	21	20.39
>15years	06	05.82
Total	103	100.00

The preliminary diagnosis on admission of patients who needed MV were respiratory 42(40.78%) followed by neurological 29(28.15%), miscellaneous 22(21.35%) and cardiac 10 (9.70%) illnesses. (Table 2) Among respiratory and neurological illnesses, pneumonia and status epilepticus were the commonest causes. The co-morbid conditions like anemia 16(15.53%), malnutrition 12(11.65%), Epilepsy 7(6.8%) and cerebral palsy 2(1.94%) were also present.

Table 2: Preliminary diagnosis on admission on MV Children

Preliminary diagnosis	Number of patients	Percentage (%)
Respiratory		
Pneumonia	26	25.24
Acute Bronchiolitis	08	07.77
ARDS	04	03.88
Status Asthmaticus	04	03.88
Neurological		
Status Epilepticus	11	10.68
GBS	08	07.77
Acute Encephalitis	07	06.80
Acute Encephalopathy	02	01.94
Neurodegenerative disorder	01	00.97
Miscellaneous		
Sepsis	15	14.57
Dengue Hemorrhagic Fever	03	02.92
Diabetic Ketoacidosis	02	01.94
Snake Bite	01	00.97
Tetanus	01	00.97
Cardiac		
Congenital Heart Disease	05	04.85
Cardiomyopathies	04	03.88
Rheumatic Valvular Heart Disease	01	00.97
Total	103	100.00

The indications for intubation and MV were highest with respiratory failure 31(30.09%), followed by cardiorespiratory failure 23(22.33%). The indications for intubation and MV are shown in Table 3.

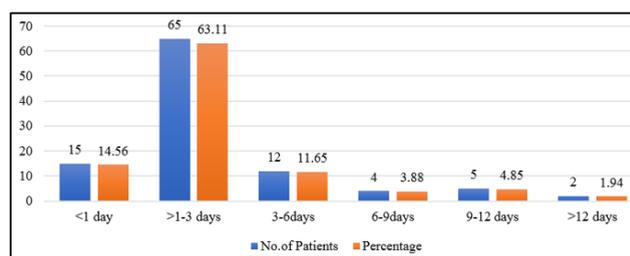
Table 3: Indications for intubation and MV in patients.

Indications for Intubation and MV	Number of patients	Percentage (%)
Respiratory Failure	31	30.09
Cardiorespiratory Failure	23	22.33
Poor Glasgow Coma Scale ($\leq 8/15$)	11	10.68
Airway Maintenance	10	09.70
Respiratory Muscle Paralysis	09	08.74
Impending Respiratory Failure	08	07.77
Severe Acidosis	06	05.83
Congestive Cardiac Failure	05	04.86
Total	103	100.00

All patients were ventilated with pressure support modes either Synchronized Intermittent Mandatory Ventilation (SIMV) or with Pressure Control(PC) depending upon the severity of illness. Out of 103 patients, 65(63.10%) and 38(36.90%) ventilated with SIMV and PC modes respectively.

Also, the median duration of MV was 3 days and maximum patients 65(63.10%) reside in MV for $\geq 1-3$ days.

(Figure 1) The median duration of hospital stay was 6 days in MV patients.

**Fig. 1:** Duration of MV

A total number of complications occurred in MV patients were 44(42.72%) out of total 103 patients. The laryngeal edema with stridor 20(19.42%) was the commonest complication post-extubation while endotracheal tube blockage 08(07.77%) was the commonest complication during ventilation. VAP was observed in only 2(01.94%) patients and was caused by Klebsiella pneumoniae. Distribution of complications occurred in patients during MV and post extubation is shown in Table 4.

Table 4: Distribution of complications in patients during MV.

Complications	Number of Patients	Percentage (%)
Laryngeal edema with stridor	20	19.42
Endotracheal Tube Block	08	07.77
Pneumothorax	06	05.82
Accidental Extubation	04	03.88
Atelectasis	03	02.91
Ventilator Associated Pneumonia	02	01.94
Pulmonary Hemorrhage	01	00.97
Total	44	42.72

The immediate outcome of patients who needed MV was highest in improved and discharged 60(58.25%) category while death occurred in 38(36.89%) The outcome of MV patients is shown in Table 5.

Table 5: The outcome of patients on MV.

Outcome	Number of Patients	Percentage (%)
Improved and discharged	60	58.25
Death	38	36.89
Discharge against Medical Advice	05	04.86
Total	103	100.00

The highest number of deaths 9(23.68%) occurred in sepsis followed by 8(21.05%) pneumonia patients. A significant correlation ($p=0.02$) was found between death on

MV with comorbid conditions like malnutrition, anemia and cerebral palsy.

4. Discussion

The incidence of MV in PICU varies from 14-60% in different parts of the country. In our study, 13.08% (103/1348) critically ill children received MV. Similar incidence of 15.93% and 9.11% was observed by Bhor NS et al² and Hatti S et al³ respectively. The incidence of MV was less in our study as compared to study done by Vijaykumary et al⁶ (52%) from Srilanka. Khemani et al¹ from united states observed 30% of children admitted to PICU were received MV. The factors behind this wide variation in the incidence of MV could be probably because of severity of illness, experience and knowledge of treating physician and infrastructure of PICU. 54.37% patients were under-five years of age who required MV from our study as compared to mean age was 1±0.8 years in a study done by Hatti S et al.³ Also, the male : female ratio was 1:0.94 in our study as compared to 1.25:1 and 1.03:1 from studies done by Bhor NS et al² and Hatti S et al³ respectively.

The initial clinical diagnosis was divided into respiratory, neurological, cardiac and miscellaneous causes. Among respiratory causes pneumonia (25.24%), while status epilepticus (10.68%), congenital heart disease (04.85%) and sepsis (14.57%) were the commonest causes from neurological, cardiac and miscellaneous respectively. A study done by Hatti S et al³ observed meningitis (15.7%) among neurological cause, pneumonia (16.3%) among respiratory, congenital heart disease (9.9%) among cardiac and 29% from miscellaneous causes. The most common indication for intubation and MV in our study was respiratory failure (30.09%) due to affection of respiratory system, followed by cardiorespiratory failure (22.33%). Similar observations were noticed in studies done by Bhor NS et al,² Farias JA et al,⁹ Harel Y et al,¹⁰ and Kendirli T et al.¹¹ Studies done by Hatti S et al,³ Wolfler A et al¹² and Mukhtar B et al¹³ observed acute neurological cause as the most common indication for MV.

The choice of mode for MV was SIMV (63.10%) followed by PC (36.9%). Pressure control mode of MV was also having high mortality probably because of more severe illness and need rest to the respiratory muscles. A similar finding was observed by Bhor NS et al.²

Also, we found the median duration of MV was 3 days and maximum patients (63.10%) reside in MV for ≥1-3 days similar to study done by Hatti S et al³ and Mukhtar et al.¹³ Bhor NS et al,² Farias et al⁹ and Wolfler et al¹² observed the mean duration of 4-6 days. Kendirli T et al¹¹ observed the period of MV in their study to be 18.8±14.1 days. The median duration of hospital stay was 6 days in MV patients while Bhor NS et al² observed the mean duration of hospital stay was 11.89±12.80days. The patients who developed complications on MV had longer duration of

hospital stay.

In the present study, the complication rate was 42.72% while Bhor NS et al² found 33.33% and reported atelectasis and laryngeal edema with post extubation stridor was the commonest complication. Similarly, we also found post extubation stridor in 19.42% patients. We also reported endotracheal tube blockage (07.77%), pneumothorax (05.82%) and accidental extubation (03.88%) which could have been prevented by continuous monitoring of the patient. Surprisingly, we observed VAP only in 01.94% patients as compared to 05.56% and 11% by Bhor Ns et al² and Vijaykumary et al⁶ respectively

In our study we found the mortality rate of 36.89% with age related mortality was more in infants (28.94%). Various studies from developing countries reported variable age and mortality rate. Studies conducted by Bhor N et al² Kendirli T et al¹¹ and Shakut et al¹⁴ found almost similar mortality rate of 31.7%, 37% and 38.89% from Turkey, Pakistan and India respectively. Vijaykumary T et al⁶ found 27.6% mortality rate with highest in children above 5 years of age. Hatti S et al³ found significantly high 65.4% mortality rate and attributed to lack of respiratory therapist, lack of education and training of MV as well as delayed presentation with multiorgan dysfunction syndrome and severity of illnesses. Studies from developed countries found the mortality rate of less than 2%. To improve the outcome of MV children we should conduct continuous medical educational program for physicians and nursing staff to train about MV.

Our study has certain limitations. Firstly, this study is a retrospective and outcome of MV depends on infrastructure of PICU along with expertization of treating doctors and nurses so the study findings may not be generalized to other PICUs. Secondly MV has undergone continuous evolution in an attempt to reduce complications and mortality in patients. But, still our study helps to identify early indications of MV, to prevent iatrogenic complications and to improve the outcome of MV.

5. Conclusions

The incidence of MV in our PICU was 13.08% and the high number of patients were under-five years of age. The preliminary diagnosis of patients who needed MV was mainly respiratory (Pneumonia) and neurological (Status Epilepticus) illnesses while the indication for intubation and MV was either respiratory or cardiorespiratory failure. Post extubation laryngeal edema and endotracheal tube blockage during MV were the commonest complications occurred. The maximum number of patients were improved and discharged who were on MV while the deaths occurred mainly in sepsis and pneumonia patients.

6. Conflict of Interest

None.

7. Source of Funding

None.

References

1. Khemani RG, Markovitz BP, Curley MA. Characteristics of children intubated and mechanically ventilated in 16 PICU's. *Chest*. 2009;136(3):765–71.
2. Bhorl N, Ghate S, Chhajed P. A study of mechanical ventilation in children. *Int J Contemp Pediatr*. 2017;4(6):2088–92.
3. Hatti S, Uplankar V, Hunnalli C. Indications and outcome of ventilated children in a Pediatric Intensive Care Unit of tertiary care hospital: A retrospective study. *Indian J Child Health*. 2018;5(4):258–61.
4. Pronovost P, Wu AW, Dorman T, Morlock L. Building safety into ICU care. *J Crit Care*. 2002;17(2):78–85. doi:10.1053/jcrc.2002.34363.
5. Turner DA, Arnold JH. Insights in pediatric ventilation: timing of intubation, ventilatory strategies, and weaning. *Curr Opin Crit Care*. 2007;13(1):57–63. doi:10.1097/MCC.0b013e32801297f9.
6. Vijaykumary T, Sarathchandra J, Kumarendran B. Prospective study of ventilated patients in the pediatric medical intensive care unit of Lady Ridgeway Hospital. *Sri Lanka J Child Health*. 2012;41(3):114–7. doi:10.4038/sljch.v41i3.4598.
7. CDC.NNIS criteria for determining nosocomial pneumonia. Atlanta, GA: Department of Health and Human Services, CDC; 2003.
8. Peroni DG, Boner AL. Atelectasis: mechanisms, diagnosis and management. *Pediatr Respir Rev*. 2000;1(3):274–8. doi:10.1053/prrv.2000.0059.
9. Farias JA, Frutos F, Esteban A, Flores JC, Retta A, Baltodano A, et al. What is the daily practice of mechanical ventilation in pediatric intensive care units? A multicentre study. *Intensive Care Med*. 2004;30(5):918–25.
10. 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.
11. Kendirli T, Kavaz A, Yalaki Z, Hismi OB. Mechanical Ventilation in Children. *Turk J Pediatr*. 2006;48(4):323–7.
12. Wolfler A, Calderoni E, Ottonello G, Conti G. Daily practice of mechanical ventilation in Italian pediatric intensive care units: a prospective survey. *Pediatr Crit Care Med*. 2011;12(2):141–6.
13. Mukhtar B, Siddiqui NR, Haque A. Clinical characteristics and immediate outcome of children mechanically ventilated in a Pediatric Intensive Care Unit. *Pak J Med Sci*. 2014;30(5):927–30.
14. Shaikat FM, Jaffari SA, Malik A. Mechanical ventilation in children—a challenge. *Proc SZPGMI*. 2000;14(1):44–52.

Author biography

Anil Bapurao Kurane, Professor and HOD

Indira Anil Kurane, Associate Professor

Ashok Annasaheb Chougule, Assistant Professor

Saiprasad Onkareshwar Kavthekar, Associate Professor

Ashok Anandrao Patil, Consultant Physician

Hemant Pralhad Bharati, Assistant Professor

Cite this article: Kurane AB, Kurane IA, Chougule AA, Kavthekar SO, Patil AA, Bharati HP. Clinical profile of mechanically ventilated children aged 1 month to 18 years. *IP Int J Med Paediatr Oncol* 2022;8(2):90-94.