



Clinical Profile of Mechanically Ventilated Patients in PICU in A Tertiary Care Center, Kalaburagi

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Abstract

Background

Mechanical ventilation (MV) is one of the most common procedure performed in PICU (Pediatric Intensive Care Unit), with 20% to 64% of patients admitted requiring ventilator support. The reasons for mechanical ventilation and management strategies vary depending not only on disease state, but also on (Pediatric Intensive Care Unit) PICU's size, patient population served, clinician's experience and local protocols.

Methods

In this study, we report the clinical profile of patients, indications, complications and end results of

mechanical ventilation in children who were followed in our PICU (Pediatric Intensive Care Unit). The study aimed to assess the clinical profile and outcome of mechanically ventilated patients in PICU (Pediatric Intensive Care Unit). A prospective cohort study conducted in the PICU (Pediatric Intensive Care Unit) of the Department of Paediatrics, Mahadevappa Rampure medical college, kalaburagi, Karnataka, during the period of November 2018 to April 2020. Clinical details of all children given invasive mechanical ventilation were analysed.

Results

Our Study group included 150 children, 52% were females and mean age of 3.6yrs. The commonest clinical indication for intubation was poor GCS (Glasgow coma scale) in (54.6%) children, inability to protect airway (41.3 %) was next common. Most common initial ventilator mode used was SIMV (synchronized intermittent mandatory ventilation). Mean duration of ventilation was 2.64days. Reintubation was required in 33.33% children, mostly due to ET tube (endotracheal tube) self-extubation. Among 150 children, VAP (ventilator associated pneumonia)(18%), oral cavity injury (8%) were the common complications. Total mortality was 12% and majority were infants.

Conclusion

Mechanical ventilation is a lifesaving modality in PICU (**Pediatric Intensive Care Unit**). Mortality can be reduced in many cases with timely intervention with ventilator support. Also proper monitoring is required to reduce the complications related to prolonged ventilation.

Keywords

Mechanical ventilation, PICU, Airway, Intubation, Mortality

Background

Mechanical ventilation in children and adults are not same. The basics of gas flow apply to all age groups similarly, but anatomical and physiological differences affect the decision in selecting the type of ventilator, ventilator modes and settings.

Critically ill children generally have a multiorgan disease, who are managed in PICU and may require mechanical ventilation at some point during their stay. Around 20% to 64% of patients admitted in PICU usually need ventilator support.¹

PICU's size, number of patients ventilated, clinician's experience and local protocols affect the mechanical ventilation strategies in individual patient.^{2,3}

Mechanical ventilation is under continuous evolution. Newer modes of mechanical ventilation have been attempted in order to reduce barotrauma/volutrauma. None of the studies concluded the best ventilatory mode that provide the greatest benefit and minimum ventilator induced lung injury. Every model has precise indication that allows better application, while avoiding side effects. Though a lifesaving benefit, mechanical ventilation can result in complications and adverse effects which may prolong duration of MV itself, difficult weaning, duration of hospitalisation and increase patient mortality.^{4,5} Using mechanical ventilation demand intensive monitoring and extra care add to the treatment cost. Most PICUs are equipped with limited number of ventilators that makes the intensivist job, a challenging one, to select the appropriate patient for appropriate ventilator support, among the available resources. Hence, the knowledge of clinical profile, complications and risk for mortality in children requiring mechanical ventilation will be helpful in planning a tertiary level PICU. There are shortage of studies regarding the clinical profile of children treated with MV in PICU. Children are currently ventilated with a lower tidal volume (8.1 vs. 10.2 mL/kg), a lower peak inspiratory pressure (27.2 vs. 31.5 cm H₂O) and a higher peak expiratory pressure (7.1 vs. 6.1 cm H₂O) than 20 years ago, the impact of these changes have not been studied in recent years. In this study, we report the clinical profile of patients, indications of mechanical ventilation, complications and end results of mechanical ventilation in children who were followed in our PICU.

Aims of the Study

1. To study the indications (organ system involved), complications, and immediate outcome of children receiving mechanical ventilation in PICU.
2. To study the risk factors associated with failed weaning or poor outcome.
3. To study the number of cases that undergo reintubation.

Methods

A prospective observational study was conducted in PICU, department of pediatrics, Mahadevappa Rampure medical college, kalaburagi, during the period of October 2018 to April 2020. All children between the age group more than 1 month and less than 18 years admitted in PICU and required mechanical ventilation were included in the present study. Children who has had undergone tracheostomy before initiating mechanical ventilation and infants born less the 37 weeks of gestation were excluded from the study.

Cardiopulmonary assessment was done at admission in the Pediatric Emergency Department of the hospital and initial stabilization of the patient including intubation when needed, fluid resuscitation, inotrope initiation were carried out accordingly. RSI (rapid sequence intubation) was performed, whenever 2 to 3 pediatric residents were available in PICU. Demographic and clinical details of all the cases in the study were noted in a proforma. The details like age, gender, duration of hospital stay, immunization status, anthropometry, diagnosis, reason for mechanical ventilation, mode of ventilator, duration of ventilation, ventilator settings, ET tube size, reintubations, cause of reintubation, complications, hematological investigations, blood culture reports, ET tube culture reports, outcome, management, were noted. To

complete the outcome analysis, details of the medical records of review up to one month, after discharge from the hospital were also noted.

The ventilator devices in our PICU used provide pressure control ventilation (PCV), volume control (VCV). Settings in the ventilator is usually adjusted by the residents on duty. The children were monitored clinically, with periodic cardiopulmonary assessment, Oxygen saturation and with arterial blood gases whenever indicated and feasible. Routine daily care of patients on ventilator were done by the nursing staff. All the events related to patient on ventilator that is suctioning, blocks in ET tube etc., are all noted in the proforma.

Statistical Analysis

Descriptive and inferential statistical analysis has been carried out in the present study. The results were analysed by using SPSS version 20.0 (IBM Corporation, SPSS Inc., Chicago, IL, USA). Results on continuous measurements were presented on Mean \pm SD (Min-Max) and results on categorical measurements were presented in Frequency (Percentage).

Ethical clearance has been obtained from the "Institutional Ethics Committee" of MRMC, Kalaburagi.

Results

Our study group included 150 children, between age group > 1 month to \leq 18 yrs., who were admitted in PICU and given invasive mechanical ventilation support. Of this, highest number of patients were infants, 76 (51%) in number out of 150 children. Children aged more than 60m (5yrs) contributing were 38 (25%). The least were children aged 13 to 60 months, which is 36 (24%). The mean age is 3.6yrs. Out of 150 patients included in the study, females were 78 (52 %) and males were 72 (48%). The sex ratio in

the study is 0.92:1. The commonest clinical indication for intubation was poor GCS in (54.6%) children, inability to protect airway (41.3 %) was next common, followed by, increased work of breathing (37.3 %), inadequate oxygenation (36%), inadequate ventilation (26.6%) and gasping (14.6%).In our study, commonly

used ventilator is pressure controlled (64%), remaining (36%) required volume controlled. Out of 47 patients attempted for RSI, 22 were successfully achieved. Remaining patients required further sedation to achieve intubation.

Table 1: Rapid Sequence Intubation and Outcome

RSI Outcome	No of Cases	Percentage
Successful	22	46.8%
Not successful	25	53.2%

Most commonly used drug was midazolam, used in 72 patients. 2nd most common drug used was propofol, in 40 patients. Ketamine was used in 16 patients. Whenever difficult airway was anticipated in

view of stridor, the children were intubated with a smaller size endotracheal tube.

118 (78.66 %) children were ventilated using uncuffed tube and 32 (21.33 %) were required cuffed tube.

Table 2: Endotracheal Tube Type used for Intubation

ET Tube used for Intubation	Number of Children	Percentage
Uncuffed	118	78.67%
Cuffed	32	21.33%

Majority of children (98%) were intubated using endotracheal tubes that were appropriate for the age. 3 children with airway obstruction required smaller size tubes. It was observed that, 45.33% (68) children were ventilated for 24 to 72 hours, 38.7% (58) children were ventilated for more than 72hrs and less than 7 days, 13.33 % (20) children were ventilated for less than 24hrs, and 2.66% (4) children were ventilated for more than 7 days. The mean duration of mechanical

ventilation was 2.64 days and ranged from 4 hours to 12 days. 80% children required sedation during the mechanical ventilation support. In this study, 33.33% (50) children who were mechanically ventilated, required reintubation within 48hours. Among the children, who required reintubation, 22.66% (34) was due to self extubation, 21.33% (32) was due to ET tube block either due to secretions or blood clots. In 6.66%

(10) children, the cause of reintubation was extubation failure.

Most common complication in the ventilated patients was ventilator associated pneumonia (VAP) in

16% followed by oral cavity injury in 8% children.

Only 1 child out of the 150 children underwent tracheostomy, which was performed to overcome complications of prolong ventilation.

Table 3: Complications in Mechanical Ventilated Patients

Complications	Percentage
VAP (Ventilator associated pneumonia)	18%
Pressure sores	1.33%
Post extubation stridor	4%
Obstructive emphysema	1.33%
Oral cavity injury	8%

A total of 80 children (53.33%) needed inotropes support. The inotropes used were Dopamine, Dobutamine, Epinephrine and Norepinephrine.

Out of the 150 children ventilated, 56 were

improved, 66 were discharged against medical advice and 10 were referred to the higher center due to the non-availability of cardiac surgery facilities. Out of 150 children, 18 succumbed to death.

Table 4: Outcome of the Ventilated Patients

Outcome	Number of Cases	Percentage
Improved	56	37.33%
DAMA	66	44%
Referred	10	7%
Death	18	12%

76 patients had normal nutrition. According to the IAP classification of malnutrition, among the malnourished, 28 children were having grade 2 PEM, 24 had grade 1 PEM, 14 had grade 3 PEM, no children had grade 4 PEM and children with failure to thrive

were 8. There were no cases of severe acute malnutrition. 68(45.33%) children had no anemia at the time of admission. 64(42.66%) children had mild to moderate anemia. 18 (12%) children had severe anemia and required blood transfusion during the ventilator

support. 44(29.33%) children in our study were partially immunized. Out of 150 children, 38(25.33%) children had positive blood cultures. Most common organism isolated was klebsiella pneumonia in 10(6.66%) and pseudomonas aeruginosa in 10(6.66%), followed by staphylococcus aureus in 8(5.33%) children. 6(4%) children showed growth of CONS and

the least common was candida albicans seen in 4(2.66%) children. Sending ET tube culture was not feasible in all patients in our study due to various constraints. Among 18 samples sent, 16 samples showed growth. Most common organism isolated in ET tube tip culture was klebsiella pneumonia.

Table 5: Diagnosis of Mechanical Ventilated Children

Diagnosis		No of Cases	Percentage
Respiratory	Pneumonia	22	14.7%
	Aspiration pneumonia	6	4%
	ARDS	6	4%
	Foreign body	6	4%
	Pneumothorax	2	1.3%
TOTAL (RS)		42	28%
Cardiovascular	CHD	8	5.3%
	Others	2	1.3%
TOTAL (CVS)		10	6.6%
Neurological	Meningoencephalitis	16	10.7%
	Seizure disorder	8	5.33%
	RTA	4	2.7%
	GBS	2	1.3%
	Intracranial bleed	10	6.7%
	TBM	4	2.7%
TOTAL (CNS)		44	29.6%
Post-surgical		24	16%
Gastrointestinal	Acute gastroenteritis	8	5.33%
Hematological	Anemia in failure	6	4%
	Leukemia	2	1.3%
Others	DKA, IEM, Poisonings	14	9.33%
TOTAL		150	100

Graph 1: Diagnosis of Mechanical Ventilated Children

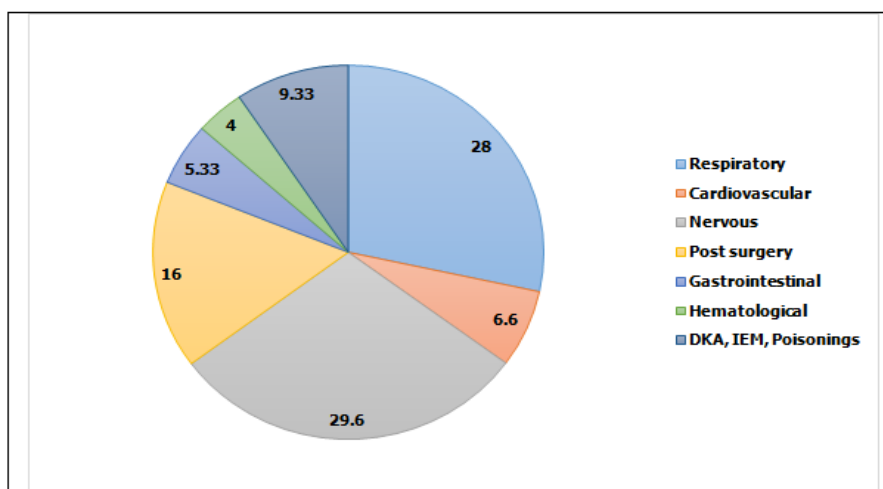


Table 6: Diagnosis and Outcomes

Systems		Improved	DAMA*	Referred	Death
Respiratory	Pneumonia	12	4	0	6
	Aspiration	2	4	0	0
	ARDS	0	6	0	0
	Foreign body	4	2	0	0
	Pneumothorax	2	0	0	0
Cardiovascular	CHD	0	2	6	0
	Others	0	0	0	2
Neurological	Meningoencephalitis	6	8	0	2
	Seizure disorder	0	6	0	2
	RTA	4	0	0	0
	GBS	2	0	0	0
	Intracranial bleed	0	6	4	0
	TBM	2	2	0	0
Post-surgical		18	6	0	0
Gastrointestinal	Acute gastroenteritis	2	4	0	2
Hematological	Anemia in failure	0	4	0	2
	Leukemia	0	2	0	0
Others	DKA, IEM, Poisonings	2	10	0	2
TOTAL		56	66	10	18

*DAMA - Discharge against medical advice

Discussion

51% of children requiring ventilation were below 1 year compared to the Shanmugham G et al study.⁶ 75% of children in this study, requiring ventilation were under-five compared to Nilofer S Bhorl et al.¹⁰ The sex ratio in the present study is 0.92:1. Unlike other studies, female predominance was observed in the present study. Rapid Sequence intubation (RSI) was performed in 14.6% of the present study population and was successful. The remaining patients required sedative drugs for intubation. The most commonly used sedative during endotracheal intubation in this study is midazolam 48%, and if failed to attain sedation, propofol or ketamine were used.

The most commonly used ventilator mode is SIMV pressure-controlled mode, followed by SIMV volume-controlled mode compared to the Shanmugham G et al study.⁶

All children were orally intubated. Most of the children were intubated using uncuffed tubes 82.66% compared to Shanmugham G et al study.⁶

Reintubation in the present study was required in 33.33% of children due to block, self-extubation and extubation failure are less, also, the most common cause in this study is self-extubation, whereas block is the most common cause for re-intubation compared to Shanmugham G et al.⁶

The mean duration of mechanical ventilation in our study was 2.64 days and ranged from 4 hours to 12 days. Mean duration of mechanical ventilation in Chitale et al⁸ study, Nilofer S Bhorl et al study,¹⁰ Ayesha Begum et al⁷ Shanmugham G et al were 4.16 days, 4.2 days, 2.4 days, 5.1 days respectively.

Regarding the complications, it is found that the complication rate in the present study was 20%, related to the delivery of mechanical ventilation.

Whereas Shanmugham G et al (48.6%) and Nilofer S. Bhorl et al studies (33.33%) show the higher rate of complications related to mechanical ventilation.

VAP is the most common complication seen in 18% of children in this study similar was observed in Shanmugham G et al study (16.9%), but the incidence is lower than that observed by Chitale et al⁸ (56%). The second most common complication observed is injury to the structures of the oral cavity seen in 8% of the children, which was comparable to Shanmugham G et al study where it 10%.

Only 1 patient out of 150 required tracheostomy in our study is 0.6%. Tracheostomy done in Shanmugham G et al study is 2.3%

53.33% of children required inotropes during mechanical ventilation in the present study, the same is observed in Shanmugham G et al study 57.7%. 45.33% of children had raised ICT in the present study.

The present study shows less mortality that is 12%, compared to various other studies. The difference observed may be attributed to the patients who were discharged against medical advice whose further follow up is not available, hence the present mortality rate may not be the true mortality rate of patients on mechanical ventilation in PICU. 54.66% of children on a ventilator had anemia in our study, which is comparable to Swati M. Gadappa et al⁹ study. 12 % of the children in our study had severe anemia and were given blood transfusion. Leucocytosis was noted in 64% of children, and the observation is similar to Swati M. Gadappa et al study.

It was noted in the present study that among the ventilated children, 29.33% of children were partially immunized which is similar to Shanmugham G et al study.

In the present study, the blood culture yield found was 25.33%, and the most common organism isolated was *Klebsiella pneumonia* and *Pseudomonas aeruginosa* which is comparable to Swati M. Gadappa et al study. Low culture positivity may be attributed to patients having received oral or parenteral antibiotics before referral to PICU.

However, the most common condition requiring mechanical ventilation in our PICU was pediatric surgery or neurosurgical postoperative cases. The most common condition requiring mechanical ventilation in PICU in our study is central nervous system pathology 29.43%, followed by respiratory pathology, comparable to Ayesha Begum et al⁷ study (27.8%), whereas the other studies have shown the respiratory pathology the most common indication for mechanical ventilation.

Total mortality in our study was found to be 12%, among that, the majority were children below 5 years age group.

Conclusion

Mechanical ventilation has become one of the major lifesaving intervention in pediatric ICUs. Mechanical ventilation is a double edged sword having both benefits and adverse effects. The work of Pediatrician does not end with intubation and connecting the child to ventilator support alone as invasive ventilation is not a treatment per se and in fact requires more man power, nursing care, time to time monitoring and identifying the complications associated with mechanical ventilation and improving outcomes. Commonly utilised ventilator type is pressure controlled type, as majority of the patients intubated were infants. RSI can be attempted whenever feasible. Sedatives must be stocked always in PICU. Uncuffed ET tubes were commonly used. Prolonged duration of

ventilation has led to complications as well as mortality related to mechanical ventilation in the present study. All procedures on ventilated patients must be done with aseptic precautions and proper sedation. Always send the ET tube tip culture and sensitivity, ventilator circuits should be sterilized after each use, these things are critical in managing the patients on mechanical ventilation.

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