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Original Article

Clinical Profile and Outcome of Ventilated Children Admitted to Paediatrics Intensive Care Unit in a Tertiary Care Centre

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Abstract

Introduction: Mechanical Ventilation is an essential tool in paediatric critical care unit. Judicious use of ventilation when indicated, is essential along with very close clinical and hemodynamic monitoring, for successful outcome. As prolonged ventilation is associated with numerous adverse outcomes, we tried to find out common complications associated with invasive mechanical ventilation and its outcome.

Methods: The study is an observational descriptive study conducted on mechanically ventilated children admitted to Paediatric Intensive Care Unit during 48 months period (November 2019 to October 2021). Demographic features included age, sex, reason for mechanical ventilation, duration of mechanical ventilation and any other comorbidities. Outcomes parameters included death in hospital, discharge from intensive care unit or shift to ward and left against medical advice (LAMA).

Results: Among 1352 children admitted to PICU, 212 children (15.68%) required invasive mechanical ventilation. Common causes for mechanical ventilation were sepsis / MODS in 22.64% cases, followed by pulmonary (20.28%) and CNS infections 39 (18.39%). 166 (78.30%) children were extubated successfully, 24 (11.32%) children expired and 22 (10.37%) went on LAMA. Mortality rate of 14.18% was found in children, who were ventilated for > 72 hours, which was statistically significant.

Conclusions: Ventilatory support is essential and lifesaving tool for critically ill children. Mortality rate was higher and statistically significant in children who were ventilated for > 72 hours.

Introduction

Ventilatory support is an essential and a common form of therapy in Paediatric Intensive Care Unit (PICU). With improvement in knowledge, understanding of disease and advancement of critical care support, this modality has evolved. Nepal is a low income country and number of critical care services targeted towards children are limited.[1] However with availability of critical services, number of children being admitted to PICU has increased in last few years. The percentage of children mechanically ventilated in different PICU varies from 14 - 60%.[2]

Mechanical ventilation can be lifesaving but more than 50% of complications in these ventilated child are related to ventilator support, if prolonged.[3] various complications associated with ventilation includes airway complications, air leaks, ventilator induced lung injury, oxygen toxicity and ventilator associated pneumonia. In conclusion, judicious use

of ventilation when indicated, is essential along with close monitoring, for successful outcome.

The objective of this study was to determine clinical profile of mechanically ventilated children, common complications associated with invasive mechanical ventilation and outcome of those children. PICU in Nobel Medical College is one of the largest referral center in Eastern Nepal. This study will guide to formulate hospital policy and help in making national guidelines as well.

Methods

The study is an observational descriptive study conducted on mechanically ventilated children admitted to PICU of Nobel Medical College and Teaching Hospital during 48 months period from November 2019 to October 2021. This study was started after acquiring approval from the Institutional Review Committee of Nobel Medical College (IRC). Nobel Medical College is a tertiary referral center located in Biratnagar, Nepal. Department of Paediatrics consists of 63 bedded paediatric ward and 15 bedded level III PICU. Various indications for ventilating a sick child includes respiratory failure, airway protection, refractory shock, and neurological disorders. Usual rate of intubation in our center ranges from 13 - 24% over few years. All ventilated children more than one month till 15 years of age were included in this study. Children who were ventilated for less than 24 hours and children who were transferred from other center on bag and tube ventilation were excluded from this study. All children were ventilated using A/C PC, PRVC or SIMV mode, depending upon the clinical scenario. Once the underlying disease process improved, if the child has adequate gas exchange and good respiratory efforts, they were weaned and extubated after spontaneous breath trial (SBT). Majority of them were extubated to either CPAP or HFNC. Demographic features were analyzed including age, sex, reason for mechanical ventilation, duration of mechanical ventilation and any other comorbidities. Outcomes parameters included death in hospital, discharge from PICU or shift to ward and Left Against Medical Advice (LAMA). Categorical data (included age, gender, underlying medical condition, outcome and complications) were expressed as absolute counts and percentages. Continuous data (for age and duration of ventilation) were expressed as mean and standard deviation. To study the association of outcome of ventilated children to with duration of ventilation, chi square test was used. Data were considered significant at p value of < 0.05. Statistical analysis was done using SPSS version 11.0 for windows.

Results

Total number of PICU admissions during the study period was 1352. A total of 212 (15.68%) of PICU admissions requiring invasive mechanical ventilation satisfied the inclusion criteria and were included in this study. Children between one to five years contributed to 32.07 % of total ventilated cases, followed by children < 1 year (26.41%) and children > 10 years (21.69%). Among them males were 53.77% and females were 46.22% as shown in fig 1.

Table 1: Showing age distribution of ventilated children admitted to PICU

Age in Years	No of cases	Percentage
< 1 years	56	26.41%
1 - 5 years	68	32.07%
5 – 10 years	42	19.8 %
>10 years	46	21.69%
Total	212	100%

Figure 1: Showing age and sex distribution of mechanical ventilated children in PICU

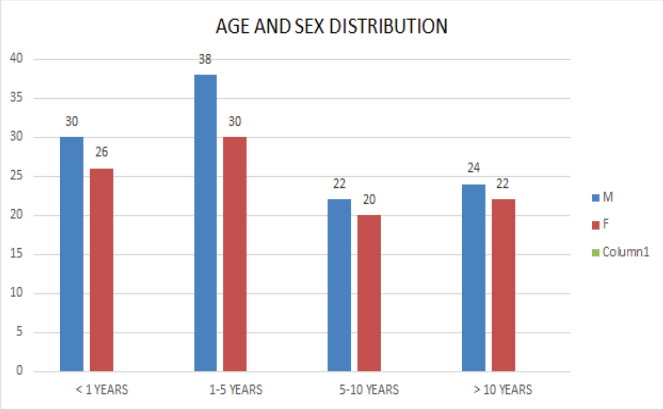

Table 2: Showing various etiologies for which children were mechanically ventilated in PICU

Clinical Diagnosis	Number of cases (Percentage)
Sepsis / Septic shock / MODS	48 (22.64%)
Pulmonary	43 (20.28%)
CNS Infection / Encephalopathy	39 (18.39%)
Cardiac	12 (5.66%)
Severe dengue	6 (2.83%)
Post-surgery	22 (10.37%)
Poisoning	10 (4.71%)
Polytrauma	10 (4.71%)
Snake bite	6 (2.83%)
MISC/ Severe Covid	6 (2.83%)
Others	10 (4.71%)
Total	212

Most common causes for requirement of mechanical ventilation were sepsis / Multi - Organ Dysfunction Syndrome (MODS) in 22.64% cases, followed by pulmonary infections (20.28%) and CNS infections / encephalopathy (18.39%). Others causes includes Guillain-Barre syndrome, submersion injury, scrub typhus and diabetic ketoacidosis.

Table 3: Showing duration of mechanical ventilation required for children

Duration of Ventilation	No. of cases	Percentage
< 72 hours	64	30.18%
72 hours to 7 days	126	59.43%
> 7 days	22	10.37%

It was observed that, among the children who were ventilated, 126 children (59.43%) were ventilated for 72 hours to seven days duration. The mean duration of mechanical ventilation was 5.38 days ± 3.66 days. Children were ventilated mainly on A/C PC, PRVC or SIMV mode, depending upon the clinical condition. Once the children improved, gradually mechanical ventilation was weaned off using either CPAP / PS, SIMV or T Piece. CPAP / PS was major method of weaning in 126 (75.90%) children, followed by SIMV in 21 (12.65%) children and T Piece in nine (6.62%) children. Some children on SIMV mode were weaned directly from SIMV by reducing rate and pressure support. However, 10 (6.02%) of children were extubated accidently, among which, six (60%) were self - extubated when sedation was stopped for SBT (Spontaneous Breathing Trial). Among 10 children accidently extubated, only three (30%) required re-intubation. We do not practice routine change of endotracheal tube in our PICU. All children ventilated for > 72 hours, we practice giving dexamethasone 0.15 mg / kg / dose every 6 hourly for 6 doses with the first dose administered 6 - 12 hours prior to extubation. However, 13 (7.83%) children required re-intubation for various reasons, the commonest cause being extubation failure due to poor respiratory efforts in six cases (46.15%), followed by airway edema in four cases (13.33%) and displacement in three cases (23.07%).

Although, mechanical ventilation is a lifesaving procedure, it can cause multiple complications. Some of the complications can be life threatening as well. The commonest complication in the ventilated children was ventilator associated pneumonia in 16 (7.54%) children, followed by air leaks in 15 (7.07%) children. The various complications encountered in ventilated children in PICU were as follows:

Table 4: Showing various complications associated with mechanical ventilation in PICU

Complications	No of cases	Percentage
Ventilator associated pneumonia	16	7.54%
Air leaks	15	7.07%
Pressure sores	15	7.54%
Post extubation stridor	14	6.60%
Collapse / Atelectasis	12	5.66%
Pulmonary haemorrhage	8	3.77%
Equipment failure	6	2.83%

Only four children (1.88%) required tracheostomy, which was required as children required prolonged mechanical ventilation. Among them three had Acute Encephalitis Syndrome with refractory status epilepticus and one child had drowning leading to hypoxic ischemic brain injury. Out of 212 children, 166 (78.30%) were successfully extubated and discharged, 24 (11.32%) children expired and 22 (10.37%) children went on LAMA. Out of 22 children, who went on LAMA, 12 (54.54%) went on LAMA due to poor neurological outcome of child whereas 10 (45.45%) children went on LAMA due to financial issues.

Table 5: Showing relation of mechanical ventilation >72 hours with outcome

Duration of ventilation	Survived	Expired	
< 72 hours (Total 64 cases)	61 (95.31%)	3 (4.68%)	P value – 0.045
> 72 hours (Total 148 cases)	127 (85.81%)	21 (14.18%)	

Out of 212 cases, 64 cases (30.18%) were mechanically ventilated for < 72 hours and 148 cases (69.81%) were ventilated for > 72 hours. Out of 24 children expired, three (12.5%) children were ventilated for < 72 hours whereas 21 (87.5%) children were ventilated > 72 hours. The mortality rate of 14.18% was found in children, who were ventilated for > 72 hours, which was statistically significant (p value 0.045).

Discussion

PICU is a place where critically ill children requiring various organ supports are admitted. Though PICU set up in Nepal is still an emerging specialty, need and requirement for PICU is still rising. Therefore this study will give an idea and highlight about disease in children requiring invasive mechanical ventilation, complications associated with it and outcome. The percentage of children in PICU requiring mechanical ventilation in our study was 15.68%, similar to study done in Pakistan by Bhori NS et al[4] whereas

study done by Vijayakumary et al[5] and Mukhtar B et al[6] showed higher rates of mechanical ventilation 52% and 50.7% respectively. Children between one to five years of age constituted 32.07% of our ventilated case, followed by infants in 26.41% of cases, similar to other studies.[4-6] Commonest indications for mechanical ventilation in our study was septic shock / MODS (22.64%), followed by respiratory failure (20.28%) unlike other studies, where neurological indications predominated in the study by Kendirli et al[7] and respiratory cause was predominated in study by Indrajit et al.[8] The mean duration of mechanical ventilation was 5.38 days ± 3.66 days, which is similar to study done by Wolfler A et al.[9]

Out of 13 (7.83%) children requiring re-intubation for various reasons, the commonest cause was extubation failure in six cases (2.8%), followed by obstruction in four cases (1.88%) and displacement in three cases (1.41%). Nosocomial pneumonia was significantly associated with reintubation, which was also reported by the study by Elward et al.[10] The commonest complication in the ventilated children was ventilator associated pneumonia in 16 (7.54%) cases and air leaks in 15 (7.07%) children. Similar findings were observed in study by Benjamin et al,[11] where incidence of air leak was reported 6.9%. 1.88% children required tracheostomy, which was required as children required prolonged mechanical ventilation, similar to Da Silva et al.[12] Mortality in the ventilated children in the study was 11.32% which was comparable to study done by Da Silva et al[12] and Indrajit et al[8] (19.8 % and 24% respectively). However it is much lower compared to the observations made by Kendirli et al[7] where mortality was 58.3%, which could be attributed to large number of manual ventilated cases in the study, where lung pressure would not be regulated leading to excessive lung injury.

The mortality rate of 14.18% was found in children, who were ventilated for > 72 hours, which was statistically significant (p value 0.045). This can be explained by the fact that children requiring prolonged ventilation, will have higher chances of ventilator induced lung injury and will have higher risk for ventilator induced infection and other complications. One major limitation in our study was lack of categorizing cases based on severity, which could have further highlighted mortality and morbidity parameters. Children ventilated for less than 24 hours and children who were transferred from other centers on bag and tube ventilation were excluded from this study, which might have resulted in lower mortality rate. Only duration of invasive mechanical ventilation was correlated with outcome, there could be various other factors affecting mortality like disease severity, co-morbidities. This is single center study, similar multicenter study from various PICU is required for further standardization of level of care in PICU.

Conclusions

Ventilatory support is essential and lifesaving tool for critically ill children, admitted to PICU. Around 15.68% of children admitted to intensive care unit requires ventilator support with common indication being sepsis, septic shock and MODS. Organized and effective courses and trainings dedicated to healthcare personnel working in PICU will reduce chances of complications associated with mechanical ventilation. Similar studies from other PICU will help in developing protocols for mechanical ventilation in critically ill children.

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