

Indications and outcome of ventilated children in a Pediatric Intensive Care Unit of tertiary care hospital: A retrospective study

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ABSTRACT

Introduction: Mechanical ventilation (MV) is frequently used as one of the most frequent life-supportive technology in Pediatric Intensive Care Units (PICUs). **Objectives:** The objectives of this study are to assess the frequency, indications, and immediate outcomes in mechanically ventilated pediatric patients in the tertiary care center of developing country. **Materials and Methods:** A retrospective observational study was conducted among critically ill pediatric patients admitted in PICU of our institute, who required MV over the 2-year period. SPSS Software Version 22.0 was used for the statistical analysis. Quantitative data were analyzed using mean and standard deviation, and Chi-square test was used for comparing differences between categorical variables. **Results:** A total of 1735 patients were admitted to PICU, and 9.11% of them required MV support. The mean age in years was 1 ± 0.8 years. The male/female ratio was 1.03:1. Common indications for MV were neurological (30.18%) followed by respiratory diseases (27.67%) and cardiac diseases (11.32%). The mean length of MV was 72 ± 04 h in our hospital. The mortality rate of children with MV (65.4%) was more as compared to the overall mortality rate in PICU (5.76%). The improvement rate was 20.72% and 14% children left against medical advice. **Conclusions:** About 9.16% of PICU admissions required MV, with most common indication being neurological illness followed by respiratory and cardiac. Severe acute malnutrition and ventilator-associated pneumonia were associated with high mortality.

Key words: Children, Mechanical ventilation, Outcome, Ventilator-associated pneumonia

Mechanical ventilation (MV) is a life-supporting device to maintain the respiratory physiological function at the time of acute respiratory failure [1]. Although lifesaving, it is associated with several complications and is the most common site where the possibility of medical errors is more. The possible reason behind this may be the duration of ventilation, which is usually prolonged, scarcity of the important resources, which normally happens in the Intensive Care Unit (ICU) of developing countries and the complex nature of the disease. MV is being used increasingly in pediatric ICUs (PICUs) nowadays. The percentage of mechanically ventilated infants and children varies from 30 to 64% [2-5].

A lot of literature about the indication and outcome of MV in the western world is available, but very little data are available from Asian countries like India regarding the use of MV in PICUs. Hence, the objective of the present study was to assess the frequency, indications, and immediate outcomes in mechanically ventilated pediatric patients in the tertiary care center of developing country.

MATERIALS AND METHODS

A retrospective descriptive study was conducted among children of the age of 0–12 years over the period of 2 years (January

2014–December 2015). Ethical clearance was obtained from the Institutional Ethical Committee. Written informed consent was taken from the parents/caregivers of the children. All children in the age group of 0–12 years admitted to our PICU and who required MV were included in our study. Surgical causes for MV like road traffic accidents who required MV and whose parents did not give consent were excluded from the study.

The PICU of our hospital is well equipped, with well-trained nursing staff and resident doctor. Ventilation was initiated with orotracheal tube, and all were ventilated with a non-cuffed tube with pressure control with either synchronized intermittent MV or assisted controlled ventilation mode depending on the patient. Investigation and treatment such as complete hemogram, chest X-ray, and arterial blood gas were all done according to the unit protocols.

The medical records of these children were reviewed retrospectively and recorded in a standard pro forma. It includes the following information on demographic details, history, clinical sign and symptoms, indications for MV, and the outcome. The indications for MV were classified as (a) central nervous system (CNS) causes (e.g., status epilepticus, CNS malformation, and meningitis), (b) respiratory causes (pneumonia, bronchiolitis, asthma, and foreign body), (c) cardiac causes (congenital heart

disease, cardiomyopathies, and congestive cardiac failure), and (d) miscellaneous causes (septicemia, poisoning like amitraz, snake bite, and scorpion sting). The outcome of the child was recorded with respect to the duration of stay on the ventilator, an immediate outcome like extubation and improved, died on the ventilator or left against medical advice (LAMA).

Severe acute malnutrition (SAM) was defined as weight-for-age or weight-for-height z score <-3 of the median of the National Center for Health Statistics [6]. We have also included the children with marasmus, or kwashiorkor, or marasmic-kwashiorkor defined according to the Welcome classification [7]. Ventilator-associated pneumonia (VAP) was defined as nosocomial bacterial pneumonia occurring after 2 days of MV.

Statistical Analysis

Data were analyzed using the SPSS software version 22.0 (Statistical Package for the Social Sciences, IBM Inc., New York). For quantitative data, mean and standard deviation were calculated. Chi-square test was used for comparing differences between categorical variables. For interpretation of results, significance was adopted at $p < 0.05$ at 95% confidence interval.

RESULTS

A total of 1735 children were admitted our hospital, and among them, 159 children fulfilled the inclusion criteria and included in the study (Fig. 1).

The mean age of the study population was 1 ± 0.8 years, and male:female ratio was 1.03:1. Majority of (46.5%) them belonged to lower socioeconomic status and reside in the rural area (74.9%) (Table 1).

An indication of MV reported was neurological, respiratory, cardiac, and miscellaneous causes. Among neurological causes, meningitis (15.7%) was the most common found, pneumonia (16.3%) in respiratory causes, congenital heart disease (9.9%) among cardiac causes, and miscellaneous causes (29.5%) (Table 2).

The median duration of MV was 3 days, and 55% of children reside in MV for 1–3 days (Fig. 2).

The immediate outcome of children is shown in Fig. 1. The mean length of MV was 72 ± 4 h in our hospital. It was found that 65% of children died on MV, 21% improved, and 14% children LAMA. The mortality rate of children mechanically ventilated (65%) was more as compared to the overall mortality rate, of in PICU was 5.76%. A significant correlation ($p = 0.00024$) was found between SAM with the outcome of patients on MV. It was noted that of 104 children who expired on the ventilator, 60 were having SAM. Similarly, a significant correlation ($p = 0.04$) was also found between the development of VAP with the outcome. Among 104 children, who died in MV, 45 of them had developed VAP.

DISCUSSION

The percentage of pediatric patients mechanically ventilated in different PICUs varied from 14 to 60% [2–4]. In our study, we found that 9.11% (159/1735) of children admitted to our PICU received MV. The finding of our study was less as compared to a study done by Vijayakumary *et al.* [5]. They reported that 52% of children received MV in Sri Lanka. Another study done by Khemani *et al.* [8] found that 30% of children admitted to PICU in the United States were mechanically ventilated. Several factors such as regionalization of PICUs, political admission

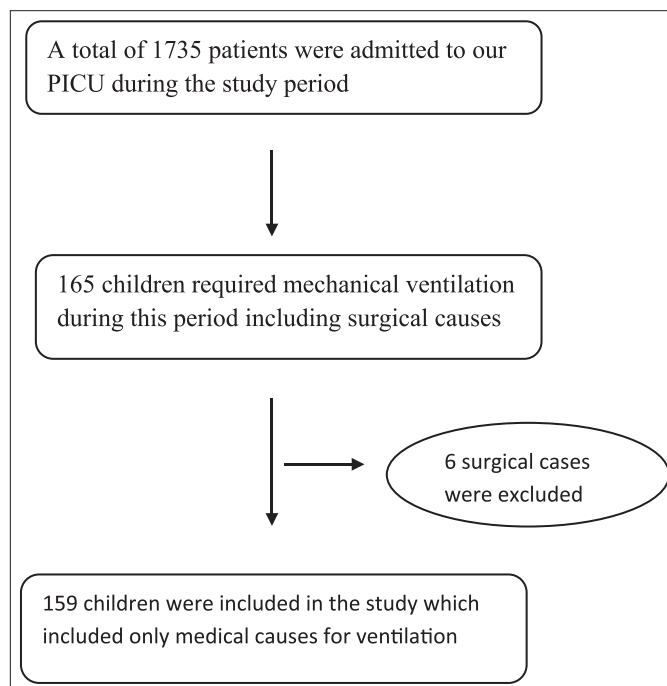


Figure 1: Flowchart of the study subjects

Table 1: Demographic details of the cases

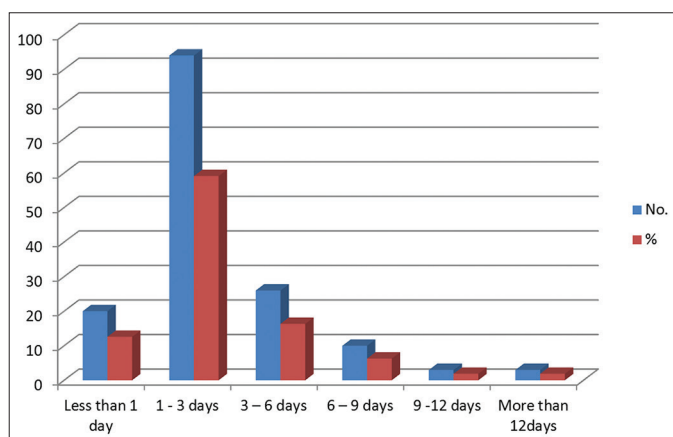
Parameters	Number of cases (%)
Age (in years)	
<1	44
1–3	21
3–6	12
6–12	23
Sex	
Male	81 (50.92)
Female	78 (49.05)
SES	
High	5 (3.14)
Upper middle	10 (6.28)
Lower middle	25 (15.7)
Upper lower	45 (28.3)
Lower	74 (46.5)
Residence	
Urban	40 (25.1)
Rural	119 (74.9)

SES: Socioeconomic status

Table 2: Indication for MV

Indication for ventilation	Number of cases (%)
Neurological causes	
Meningitis	25 (15.7)
Status epilepticus	15 (9.4)
CNS malformation	6 (2.4)
Neuromuscular disease	2 (0.8)
Respiratory causes	
Pneumonia	26 (16.3)
Bronchiolitis	16 (9.9)
Asthma	3 (1.88)
Upper airway obstruction	1 (0.4)
Cardiac causes	
Congenital heart disease	16 (9.9%)
Cardiomyopathies	2 (3.76%)
Miscellaneous causes such as septicemia, poisoning like amitraz, and snake bite scorpion sting.	47 (29.5%)

MV: Mechanical ventilation, CNS: Central nervous system

**Figure 2: Duration of mechanical ventilation**

and discharges of PICUs, the severity of illness, and seasonal variation could explain the wide variability in the percentage of mechanically ventilated children.

The average duration of MV in our study was 72 ± 4 h. Similar results were seen in a study done by Mukhtar *et al.* [9] in Pakistan where the average duration was 48 ± 2 h. Wolfler *et al.* [10] and Farias *et al.* [11] found the mean duration of 4–6 days. Neurological cause (35.8%) was the most common indication for MV in our study. Similar results were found by a study done by Wolfler *et al.* [10]. In contrast to our study, several other studies found respiratory failure as the most common indication of MV in PICUs [11–13]. The mortality rate of our ventilated children was 65.41%. In studies conducted by Shaukat *et al.* [14] and Kendirli *et al.* [12], a mortality rate of 37% and 31.7% from Pakistan and Turkey was found, respectively. Vijayakumary *et al.* [5] reported mortality rate a mortality rate of 27.6%.

In our study, malnourishment and the development of VAP were significantly correlated with higher mortality of mechanically

ventilated children. Different studies found various other independent risk factors for higher mortality such as acute cardiac failure and prolonged ventilator stay by Mukhtar *et al.* [9]. There are several reasons for this major difference in the mortality rate of MV children. Several advantages including a higher number of post-operative cases in their PICUs, trained staff, availability of respiratory therapist, and early presentation of illness are known for established PICUs in developed countries [12]. Lack of respiratory therapist services, lack of education and training of MV as well as a delayed presentation with multiorgan dysfunction syndrome are some attributable causes for our high mortality.

To improve the outcome of MV children in PICUs, we need effective, organized, and structured educational courses from basic concept to clinical application for all physicians and nurses involved in the care of critically ill children receiving MV and also an early referral from the periphery. Our study has certain limitations. First of all, this study was a retrospective study, and hence, it was difficult to generalize the findings of the study. Hence, further randomized controlled trials with larger sample size should be conducted at a community level.

CONCLUSION

The findings of the study suggest that neurological, respiratory, cardiac, and miscellaneous causes were the most common indication for MV. A total of 55% children reside in MV for 1–3 days. Malnutrition and VAP were significantly correlated with higher mortality in these children.

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