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Research Article

Clinical profile of children mechanically ventilated in a pediatric intensive care unit of a limited resource setting

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ABSTRACT

Background: Mechanical ventilation, a lifesaving intervention in a critical care unit is under continuous evolution in modern era. Despite this, the management of children with invasive ventilation in developing countries with limited resources is challenging. The study analyses the clinical profile, indications, complications and duration of ventilator care in limited resource settings.
Methods: Retrospective study of critically ill children mechanically ventilated in an intensive care unit of a tertiary care government hospital.
Results: A total of 111 children required invasive ventilation during the study period of 1 year. Infants constituted the majority (68.5%), and males (59.5%) were marginally more than female children (40.5%). Respiratory failure was the most common indication for invasive ventilation (51.4%). The major underlying etiology for invasive ventilation was bronchopneumonia associated with septic shock (28.8%); and the same also required a prolonged duration of ventilation of > 72 hours (34.3%). Prolonged ventilator support of >72 hours predisposed to more complications as well as a prolonged hospital stay of >2 weeks and above, which was statistically significant. Upper lobe atelectasis (47.4%) and ventilator associated pneumonia (21.1%) were the major complications. The mortality rate of our study population was 36.9% as opposed to the overall mortality of 8.3%.
Conclusions: Our study highlights that critically ill children can be managed with mechanical ventilation even in limited resource settings. The child should be assessed clinically regarding the tolerance to extubation every day, to minimise the complications associated with prolonged ventilator support. A favourable outcome requires good nursing care and meticulous management by an intensivist.

Keywords: Bronchopneumonia, Mechanical ventilation, Upper lobe atelectasis, Ventilator associated pneumonia

INTRODUCTION

Critical illness is an alteration in body's basic physiology leading to organ dysfunction, long term morbidity and even death if there is no appropriate and timely intervention. Mechanical ventilation is the highest form of respiratory support in a critical care unit. It is a lifesaving intervention to support the cardio respiratory status, until the underlying disease is cured. Invasive mechanical ventilation is under continuous evolution with introduction of various new modes of ventilator support. Although lifesaving, it is associated with complications especially if ventilator care is prolonged, and also with the drawback of limited resources in intensive care units of developing countries. The percentage of mechanical ventilation in paediatric intensive care unit (PICU) ranges from 30-64%.[1] Very less data is available from developing countries regarding the use of mechanical

ventilation in PICU. The objective of this study was to assess the indications, complications and immediate-outcome of children receiving mechanical ventilation in a PICU of a tertiary-care hospital from a developing country.

METHODS

We retrospectively reviewed the medical records of all children from one-month to twelve years who received mechanical ventilation in a paediatric intensive care unit of a government tertiary care hospital, from November 2013 to September 2014. Our critical care unit is 6 bedded with an annexe of 20 beds to care for children post stabilisation. Our annual PICU admissions are around 600 cases, of which around 130 cases require mechanical ventilation. Children were monitored clinically by regular cardiopulmonary cerebral assessment along with cardiac monitor and pulse oximetry. The decision to intubate was on clinical grounds based on the Paediatric assessment triangle.[2]

The various indications for mechanical ventilation were analysed. The duration of invasive ventilation was divided as <72 hours and >72 hours based on a study done in Haryana, which had 72 hours as the maximum duration of invasive ventilation.[3] We divided the cases as after spontaneous and planned extubation and also analysed the causes of reintubation. A complication was attributed to mechanical ventilation if it was not present before and it developed during ventilation. Ventilator associated pneumonia (VAP) was considered when clinical and laboratory findings of pneumonia were present at or after 48 hours of mechanical ventilation. Post extubation stridor was defined as the stridor that develops following extubation, due to edema of glottis, which can be due to prolonged intubation or larger size endotracheal tube used. Upper lobe collapse was defined as a triangular opacity, with loss of lung volume, crowding of ribs, tracheal shift to same side, and elevation of hemidiaphragm.

Statistics analysis

The Categorical variables were expressed as Frequency and percentage. The Quantity variables were expressed as mean $\pm$ standard deviation. Descriptive statistics were used to evaluate baseline characteristics. The group comparisons for the categorical variables were analysed using Chi square test and within group, comparisons of quantitative variables were analysed using independent t test. The p value of less than 0.05 was considered as statistically significant. The statistical analysis was carried out using statistical software SPSS 19.

RESULTS

During our study period of one year, we had 111 children who required mechanical ventilation in our critical care unit. Majority (68.5%) of the study population were infants (n=76). We had 66 male and 45 female children. All patients were ventilated by pressure modes such as assist control (AC), synchronised intermittent mandatory ventilation (SIMV), pressure support ventilation (PSV) etc., based on clinical assessment.

Respiratory failure was the most common indication for invasive ventilation contributing to 51.4% (Figure 1). The major underlying etiology for invasive ventilation was bronchopneumonia associated with septic shock observed in 28.8%, and the same also required a prolonged duration of invasive ventilation of >72 hours being around 34.3%.

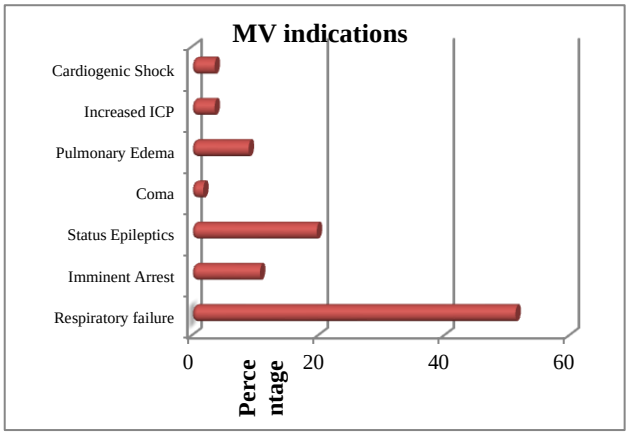

Figure 1: Mechanical ventilation - indications.

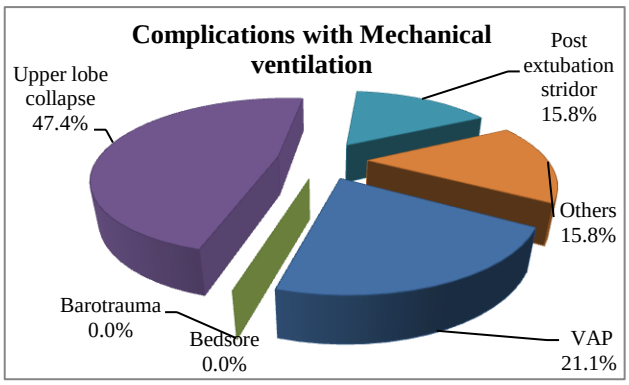

Figure 2: Complications with mechanical ventilation.

Table 1: Mechanical ventilation duration & duration of hospital stay.

Mechanical ventilation duration	Duration of hospital stay			Total
	<7 days	7-14 days	>14 days	
<72 hrs	38 (52.1%)	33 (45.2%)	2 (2.7%)	73
>72 hrs	4 (11.4%)	18 (51.4%)	13 (37.1%)	35
Total				108

P=0.002

We also observed that children who required prolonged ventilator support of >72 hours had a longer duration of hospital stay, as well as more complications. This observation was statistically significant (Table 1, 2). Upper lobe atelectasis (47.4%) and ventilator associated pneumonia (21.1%) were the major complications observed in our study (Figure 2). The rate of spontaneous extubation in our study was 3.6%, and reintubation rate was 3.8%.

Table 2: Mechanical ventilation: duration & complications.

Mechanical ventilation duration	VAP	Upper lobe collapse	Post-extubation stridor	Others	Total no.
< 72 hrs	0	3 (50%)	3 (50%)	0	6
>72 hrs	4 (30.8%)	6 (46.2%)	0	3 (23%)	13
	4	9	3	3	19

P=0.021

In our study population 83 children (75%) were haemodynamically unstable. We had 24.3% of children with associated comorbid conditions. HIE sequelae/cerebral palsy and congenital heart disease were the major comorbid conditions in our study. The mortality rate of our study population was 36.9%.

DISCUSSION

A total of 111 children required invasive ventilation during the study period of 1 year. Infants contributed to 68.5% of the study population. Respiratory failure was the most common indication for mechanical ventilation in our study contributing to 51.4%. This was supported by other studies. Kendirli et al in their study observed respiratory failure as the indication in 64.8% of cases[1] whereas it was 59.18% in a study by Dafne Cardoso in Brazil.[4] Farias et al observed acute respiratory failure as the cause for initiation of invasive ventilation in 72% of the cases.[5] Based on underlying disease etiology, bronchopneumonia with associated septic shock was the major condition which required invasive ventilation and also required a prolonged respiratory support of >72 hours. Valerie Payen et al in their study also observed that associated hemodynamic instability prolonged the duration of invasive ventilation.[6]

We analysed that children who required mechanical ventilation for a longer duration of >72 hours, had a prolonged hospital stay which was statistically significant. We also found that all cases ventilated for increased intracranial pressure, required a longer ventilator support whereas children intubated for pulmonary edema and status epilepticus required a shorter duration.

Majority (68.4%) of the complications occurred in the group which required prolonged ventilator support of >72 hours. In our study upper lobe collapse was identified as the commonest complication contributing to 47.4% followed next by VAP accounting for 21.1%. It was also observed that all cases of VAP occurred in the >72 hour group. Srinivasan et al observed 32% of VAP in their study, 10.7% by Casado et al, 17.5% by Kendirli et al, and 27.4% in the study done by Tullu et al.[1,7-9] Atelectasis was the commonest complication in the study by Kendirli et al attributing to 26.3%, whereas it was 13.8 % in the study by Wang, et al. [1,10]

In our study 3.6% of cases spontaneously extubated. The overall reintubation rate in our study was 3.8%. Among the cases which had reintubation, 40% were due to spontaneous extubation. Farias et al in his study observed that 4% of children had spontaneous extubation and the reintubation rate was 10%.[5] Studies have shown that unplanned extubation amounts to 3-13 % and the reintubation rate following this as 30%.

Comorbidity was present in 24.3% of the study population. The major comorbid conditions in our study were HIE sequelae/cerebral palsy and congenital heart disease. Volakli et al observed a comorbidity of 41.3% in their study.[11] Payen V et al in their study had congenital heart disease as the major comorbidity.[6] The mortality rate among the mechanically ventilated patients in our study was 36.9% as compared to the overall mortality rate of our critical care unit of 8.3%. Singhal et al and Jeena et al observed a mortality of 18-35% in their studies.[12,13] A high mortality of 58.3% was observed among mechanically ventilated children in a study by Kendirli et al.[1] Mortality rate as low as 4.5% was observed by Tan et al.[14]

The limitation for our study was that, being a public sector with limited resources, blood gas analysis was not done for our patients. We resorted only to non-invasive monitoring of vital signs-pulse oximetry, cardiac monitor etc. along with bedside clinical assessment to monitor our patients. The study highlights that critically ill children can be managed in resource poor settings in an effective way and invasive ventilation need not be denied on the grounds of absence of ABG analysis.

CONCLUSION

We observed respiratory failure as the most common indication for invasive ventilation (51.4%). Prolonged ventilation of >72 hours was associated with longer

hospital stay of 2 weeks and above and more complications. The most common complication observed in our study was upper lobe atelectasis (47.4%), followed by ventilator associated pneumonia (21.1%). Mechanical ventilation is a lifesaving intervention in a critical care unit. The job of a physician does not end with intubation and connecting the patient to ventilator support alone; as invasive ventilation is not a treatment per se. The underlying disease warranting this respiratory support should be identified and treated. A favourable outcome requires good nursing care and meticulous management by an intensivist

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