International Journal of Contemporary Pediatrics
Ankireddy K et al. Int J Contemp Pediatr. 2019 Mar;6(2):574-577
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20190689

Original Research Article

A study on symptoms of children mechanically ventilated in a paediatric intensive care unit of a minimum resource setting in tertiary care centre

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Received: 28 December 2018
Accepted: 31 January 2019

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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: A retrospective study of critically ill children mechanically ventilated in an intensive care unit of a tertiary care government hospital.
Results: A total of 120 children required invasive ventilation during the study period of 1 year. Infants constituted the majority (70%), and males (65%) were marginally more than female children (35%). Respiratory failure was the most common indication for invasive ventilation (55%). The major underlying etiology for invasive ventilation was bronchopneumonia associated with septic shock (30%); and the same also required a prolonged duration of ventilation of >72 hours (35%). 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 (50%) and ventilator associated pneumonia (25%) were the major complications. The mortality rate of present study population was 40% as opposed to the overall mortality of 10%.
Conclusions: Present 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.

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.[1-5] The percentage of mechanical ventilation in pediatric 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

Authors retrospectively reviewed the medical records of all children from one-month to twelve years who received mechanical ventilation in a pediatric intensive care unit of a government tertiary care hospital, from November 2015 to September 2016. Our critical care unit is 6 bedded with an annexed of 20 beds to care for children post stabilization.

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 Pediatric assessment triangle.[2]

The various indications for mechanical ventilation were analyzed. 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] Authors 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.

Stastical analysis

The categorical variables were expressed as frequency and percentage. The quantity variables were expressed as mean±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 present study period of one year, authors had 120 children who required mechanical ventilation in our critical care unit. Majority (70%) of the study population were infants (n=84). Authors had 78 male and 42 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 55%. The major underlying etiology for invasive ventilation was bronchopneumonia associated with septic shock observed in 30%, and the same also required a prolonged duration of invasive ventilation of >72 hours being around 35% (Table 1).

Table 1: Mechanical ventilation-indications.

Indications	Percentage
Cardiogenic shock	4
Increased ICP	4
Pulmonary edema	10
Coma	1
Status epileptics	16
Imminent arrest	10
Respiratory failure	55

Authors 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 and 2).

Upper lobe atelectasis (50%) and ventilator associated pneumonia (25%) were the major complications observed in present study (Figure 2).

Table 2: Complications of mechanical ventilation.

Complications	Percentage
Upper lobe collapse	45
Post extubation stridor	15
Others	15
VAP	25
Bed sore	0.0
Barotrauma	0.0

The rate of spontaneous extubation in present study was 6%, and reintubation rate was 6%. In present study population 90 children (75%) were hemodynamically unstable.

Authors had 26% of children with associated comorbid conditions. HIE sequelae/cerebral palsy and congenital heart disease were the major comorbid conditions in present study. The mortality rate of present study population was 40%.

Table 3: Mechanical ventilation duration and duration of hospital stay.

Mechanical ventilation duration	Duration of the hospital stay			Total
	<7 days	7-14 days	>14 days	
<72 hours	40	35	04	79
>72 hours	06	20	15	41
Total				120

DISCUSSION

A total of 120 children required invasive ventilation during the study period of 1 year. Infants contributed to 70% of the study population. Respiratory failure was the most common indication for mechanical ventilation in present study contributing to 55%.[3,4] This was supported by other studies. Kendirli et al, in their study observed respiratory failure as the indication in 64.8% of cases1 whereas it was 59.18% in a study by Cardoso D et al, 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. In some other studies observed that associated hemodynamic instability prolonged the duration of invasive ventilation.

Authors analysed that children who required mechanical ventilation for a longer duration of >72 hours, had a prolonged hospital stay which was statistically significant. Authors 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 (70%) of the complications occurred in the group which required prolonged ventilator support of >72 hours. In present study upper lobe collapse was identified as the commonest complication contributing to 47.4% followed next by VAP accounting for 25%. 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.[1,9] 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 present study 6% of cases spontaneously extubated. The overall reintubation rate in present study was 6.8%. Among the cases which had reintubation, 45% 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 26% of the study population. The major comorbid conditions in present 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 present study was 40% as compared to the overall mortality rate of our critical care unit of 10%. 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 present study was that, being a public sector with limited resources, blood gas analysis was not done for our patients. Authors 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

Authors observed respiratory failure as the most common indication for invasive ventilation (55%). 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 present study was upper lobe atelectasis (45%), followed by ventilator associated pneumonia (25%). 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. The underlying disease warranting this respiratory support should be identified and treated. A favourable outcome requires good nursing care and meticulous management by an intensive visit and proper care.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Ankireddy K, Jyothi AK. A study on symptoms of children mechanically ventilated in a paediatric intensive care unit of a minimum resource setting in tertiary care centre. Int J Contemp Pediatr 2019;6:574-7.