International Journal of Medical and Health Research
www.medicalsciencejournal.com
ISSN: 2454-9142
Received: 21-08-2022, Accepted: 06-09-2022, Published: 23-09-2022
Volume 8, Issue 5, 2022, Page No. 12-15

A prospective analysis of outcome of mechanical ventilation in children admitted pediatric intensive care unit

Abhijeet Trivedi*
Specialist Pediatrician, Aster Hospital, Dubai, United Arab Emirates

Abstract
Background and aims: Mechanical ventilation (MV) is one of the most commonly performed procedures in PICU for various clinical indications. However, it imposes various complications and causes significant morbidity and mortality. So the present study was carried out to evaluate the outcome and complications in pediatric population with MV in PICU.
Materials and methods: This prospective observational study was conducted on 60 children admitted to PICU. Patients were assessed clinically and patient's data and vital clinical parameters were recorded in a proforma designed for the study.
Results: A total of 402 patients were admitted to the PICU and out of these 60 patients (14.9%) required mechanical ventilation. Respiratory disease was the most common cause for MV in 56.7% of children. The commonest associated co-morbid condition in patients requiring mechanical ventilation was PEM (71.1%) followed by Anemia (68.3%). The most common complication associated with mechanical ventilation in this study was obstruction by secretion of endotracheal tube (55%) which was followed by kinking of tube (36.6%) and VAP (30%). The mean total PRISM score in patients who survived was 6.42 and that in patients who died was 16.59. Using Pearson Chi square test the total PRISM score is significant risk factor in outcome of patient requiring mechanical ventilation.
Conclusion: Mechanical ventilation in PICU prolong the duration of hospital stay and life-threatening complications. So, suitable alternatives must be followed before the initiation of mechanical ventilation in PICU admitted children.

Keywords: children, mechanical ventilation, respiratory diseases, prism score, mortality

Introduction
Mechanical Ventilation (MV) is a life-supporting strategy used at the time of either impending or acute respiratory failure with the aims of improving gas exchange and decreasing work of breathing [1]. The percentage of children receiving mechanical ventilation in PICUs ranges from 17-64% in developed countries [2]. The mortality rate is higher in children who require MV as compared to those who do not require respiratory support [3]. Mortality of a ventilated patient depends on factors present during the initiation of ventilation, complications which develop during the course of MV and the associated co- morbidities. Hence, in order to improve the therapeutic strategies intensivists should have the knowledge of epidemiology of patients requiring MV and the risk factors of mortality which can be helpful to give quality care to ventilated patients [4].
The indications of mechanical ventilation are respiratory failure (pneumonia, bronchiolitis, lung hemorrhage, muscle disease, laryngotracheobronchitis), cardiovascular failure together with hypotension (heart failure, myocarditis, spell attack), septic shock, central nervous system disease (meningitis, encephalitis, coma, bleeding, tumor), and safety airway, especially critical situations like sepsis [5]. The reasons for mechanical ventilation and management strategies vary depending not only on disease state, but also on PICU's size, patient population served, clinician's experience and local protocols [6]. Since its introduction into the modern PICUs, mechanical ventilation has undergone continuous evolution. Newer modes of mechanical ventilation have been introduced in an attempt to reduce barotrauma/volutrauma. No data exist so far to determine the ventilatory mode that provides the greatest benefit with the minimum risk of ventilator induced lung injury. Each model has precise indication which allows better application on one hand, while avoiding side effects on the other. Though it has lifesaving benefits, mechanical ventilation can result in important complications and adverse physiologic effects which may prolong duration of MV itself, duration of hospitalization and increase patient mortality [7]. In this study, we report indications, complications and end results of mechanical ventilation in children who were followed in our PICU.

Materials and Methods
This prospective observational study was conducted in the Pediatric Intensive Care Unit (PICU) at the tertiary care hospital in public sector for a one year period. The 5 bedded PICU has an average admission rate of 40 to 50 per month. Patients are admitted after clinical assessment. Admissions may be direct admissions, transfer from wards, and other public or private hospitals.

Inclusion criteria
Infants and children on mechanical ventilator administered through endotracheal tube. Age criteria:>than 1 month and <12 years were included in the study.

Exclusion criteria
New borns (<28 days old) and Age >12 years were excluded from the study.

Study procedure
In this study, 60 children were recruited based on the inclusion and exclusion criteria. Depending on the age, the

patient was divided into1month-1year, 1year-6years and 6years-12years. Depending on the total duration of stay in PICU patients were divided into < 1day, 1 day-1week, 1week-2weeks and >2weeks.

On admission, a detailed general examination was done & clinical and laboratory parameters were recorded. The most abnormal values in first 24 hours of PICU admission were considered for data analysis.

The laboratory investigations studied were, Arterial blood gas (ABG), pH, Partial pressure of carbon dioxide - PaCO2(mm of Hg), Partial pressure of oxygen - PaO2(mm of Hg), Tension of carbon dioxide – TCO2 (mmol/L), Random blood sugar (mg/dL), Serum potassium and sodium (mmol/L), Serum creatinine (mg/dL), Blood urea nitrogen (mg/dL), White blood count – cells/mm3, Platelet count - cells/mm3, Prothrombin time –seconds and Partial thromboplastin time –seconds.

The variables were recorded & assigned limits according to the standard reference values. The investigations were carried by same set of doctors & laboratory personnel to avoid individual variations. A total of 17 variables were recorded for each consecutive admission and an admission PRISM-3 score was given. The total PRISM-3 score was calculated on admission of patient in PICU.

Date and time of ventilation, endotracheal tube size, cuffed uncuffed tube, mode of ventilation, daily ventilator settings, treatment required, sedation given, duration of ventilation and requirement of re-ventilation was noted in the course of ventilation. The complication of mechanical ventilation during and after the ventilation was noted. Outcome of patient: The outcome of patient was divided in two groups, patients survived and patients expired.

Results

In this study out of 60 children, majority of them were infants <1 year encompassing 27 (45%). The mean age of the children in the present study was 36.94 ± 7.86 months. Out of total 60 children 35 (58.3%) were males and 25 (41.7%). The male: female ratio was 1.4: 1.

The major indication for the need of mechanical ventilation was due to respiratory disease in 34 (56.7%) of the patients. Further, the commonest associated co morbid condition in patients requiring mechanical ventilation was protein energy malnutrition (71.1%) followed by Anemia (68.3%).

The most common complication associated with mechanical ventilation in this study was obstruction by secretion of endotracheal tube (53.3%) which was followed by kinking of tube (38.3%) and VAP (30%). The data were shown in table 1.

Table 1: Complications associated with mechanical ventilation

Complication	Frequency (n=60)	Percentage (%)
Ventilator associated pneumonia	18	30.0%
Obstruction by secretion	32	53.3%
Kinking of ET tube	23	38.3%
Improper tube postion	15	25.0%
Self extubation	13	21.7%
Esophageal Intubation	10	16.7%
Atelectasis	9	15.0%
Mucosal injury	8	13.3%
Pneumothorax	7	11.7%

Out of 60 patients who were mechanically ventilated, 18 patients died with a mortality rate of 30%. The highest mortality found in 1-6 years age group (31.5%). Maximum numbers of patients were infants (45%). In this the mortality was higher in patients respiratory diseases encompassing 16.6%.

A high mortality rate was present when co- morbid conditions were present in patients requiring mechanical ventilation. Patients with sepsis had a higher mortality rate (42.3%). The results were shown in table 2.

Table 2: Co-morbid condition in patient requiring ventilation and relation with outcome.

Co morbid condition	Number	Survived	Died
Anaemia	41 (68.33%)	28(68.2%)	13 (31.7%)
Transfusion	33 (55%)	22(66.6%)	11 (33.3%)
PEM	43 (71.66%)	32 (74.4%)	11 (25.5%)
Sepsis	26 (43.33%)	15(57.6%)	11 (42.3%)
Congenital heart disease	10 (16.66%)	5 (50%)	5 (50%)
Tuberculosis	9 (15%)	7 (77.7%)	2 (22.2. %)
Immunocompromised	8(13.33%)	7 (87.5%)	1 (12.5%)

Mortality was significantly higher in the group requiring two or more inotropic drug. Out of 13 patients requiring two or more drugs 12 died.

Most common complication was Obstruction of endotracheal tube by secretion (55%) followed by kinking of tube (36.6%). Mortality was higher in atelectasis (44.4%) and pneumothorax group (7.1%) and in VAP the mortality was 50%. The results were shown in table 3.

Table 3: Complication of mechanical ventilation and outcome

Complication	Total	Survived	Died
VAP	18	9	9
Atelectasis	9	5	4
Pneumothorax	7	3	4
Self extubation	13	9	4
Subcutaneous Air	1	1	0
Mucosal injury	8	1	7
Esophageal intubation	10	6	4
Kinking of tube	23	15	8
Obstruction by secretion	32	24	8
Improper tube position	15	9	6

The mean total PRISM score in patients who survived was 6.42 and that in patients who died was 16.59 and it was found to be significant (p=0.02). The results were shown in table 4.

Table 4: Prism III score and outcome

Prism score	Total	Survived	Died
0-5	14	11 (78.5%)	3 (21.4%)
5-10	16	13 (81.2%)	3 (18.7%)
10-15	13	10(76.9%)	3 (23%)
15-20	12	8 (66.6%)	4 (33.3%)
20-25	1	0 (0%)	1 (100%)
25-30	3	0 (0%)	3(100%)
30 and above	1	0 (0%)	1(100%)

In this study, 78.3% of patient required ventilation for 1 day to 1 week, followed by 13.3% for 1- 2 weeks. There was no correlation with duration of ventilation with outcome. The results were shown in table 5.

Table 5: Duration of ventilation and outcome

Duration of ventilation	Survived	Died	Total
1 day to 1week	34	13	47
1 to 2 weeks	4	4	8
More than 2 weeks	4	1	5

Discussion

Mechanical ventilation is a frequently applied therapy in critically ill children and in many cases can be lifesaving. In the present study conducted to assess the clinical profile and outcome of children treated with invasive mechanical ventilation. In this study, a maximum numbers of patients requiring ventilation were infants (45%). The mean age of patients in our study was 35.19 months. Males were more in our study with a male: female ratio of 1.4: 1. Studies done by Kendril *et al*. [8] and Rsovac *et al*. [9] also found high incidence in male children.

In this study, respiratory disease was the commonest indication for mechanical ventilation (56.7%), pneumonia being the major cause. Similar findings of pneumonia being the commonest cause of acute respiratory failure requiring mechanical ventilation were seen among the Turkish children [8]. Meanwhile, in developed countries the commonest indications are non- infectious disease like trauma, congenital heart disease and post-operative cases [10]. The mean duration of mechanical ventilation in our study was 5.47 days which was similar to that reported by Singh *et al*. with average duration of 6.5 days [11].

Of the 60 patients who were mechanically ventilated, 18 patients died with a mortality of 30%. Kendril *et al*.[8] reported a mortality rate of 58.3% and Traiber *et al*. [12] of 48% among mechanically ventilated children, which was higher compared to the present study. In our study we found that the presence of co-morbid conditions in patients requiring mechanical ventilation increased the mortality. Anaemia was present in 41 patients (61.3%) in our study which is similar in study by Bateman at al. where 74% patient had anaemia [13]. Mortality in patient with anaemia was higher than in those without anaemia (13 out of 41 died) which was also noted in above study.

Presence of associated sepsis in patients requiring mechanical ventilation increases the chances of multi-organ dysfunction therefore increasing the mortality rate. In our study 11 out of 26 patients with sepsis died. Similar results were seen in a study by David *et al*. [14] Ventilator-associated pneumonia was defined by the development of a new alveolar infiltrate persistent for 48 hours or more, accompanied by fever/hypothermia and leukocytosis/leucopenia, purulent sputum or changes in sputum, or isolation of pathogenic bacteria from an endotracheal aspirate. Ventilator associated pneumonia is the third most common complication in our study with an incidence of 30.0%. In our study mortality did not increase significantly by the presence or absence of ventilator-associated pneumonia. Suka *et al*. [15] showed that the incidence of ventilator-associated pneumonia was 12.6% which was similar to that in our study.

The development of the PRISM score for mortality prediction by Pollack *et al* has been a major step forward, allowing objective assessment of severity of illness [16]. In the United States, the PRISM score was validated as an institutionally-independent outcome predictor in the group of reference hospitals involved in the development of the prediction model [17]. The mortality increased with increase in the PRISM score. All patients with a PRISM score of more than 20 expired. The survival group had mean score of 9.78% while the expired group had a PRISM score of 10.55%.

The intubation procedure itself contributes to VAP. During intubation, the tube passes through the pharynx, which is heavily colonized with bacteria, and can facilitate the movement of organisms into the sterile lower respiratory tract [8]. Therefore, repetitive reintubation increases the risk of a patient contracting VAP. In our study mean no of intubations in cases of VAP was 3.18 times which was clinically significant [18].

Most common complication in our study was obstruction of tube by secretions (55%) and kinking of endotracheal tube during the course of ventilation (36.6%) improper tube position (25%), esophsial intubation (16.7%), self extubation (21.7%) which were comparable Souza *et al*. [19] study.

Conclusion

Based on the present study findings, 14.9 % of the PICU admissions required mechanical ventilation. Respiratory disease was the commonest indication for mechanical ventilation. Out of 60 patients mortality was observed in 30% of the children.

References

1. Haque A, Mukhtar B, Siddiqui NU. Clinical Characteristics and Immediate-Outcome of Children Mechanically Ventilated in PICU of Pakistan. Pakistan J Med Sci., 1969, 30(5).
2. Begum A, Kumar D. A Prospective Study on Clinical Profile and Outcome of Ventilated Children In A Pediatric Intensive Care Unit Of A Tertiary Care Teaching Hospital, Telangana. IOSR J Dent Med Sci., 2016.
3. Vincent JL, Akça S, de Mendonça A, Haji-Michael P, Sprung C, Moreno R, *et al*. The Epidemiology of Acute Respiratory Failure in Critically Ill Patients. Chest,2002:121(5):1602-9.
4. Wu D, Wu C, Zhang S, Zhong Y. Risk Factors of Ventilator-Associated Pneumonia in Critically III Patients. Front Pharmacol, 2019, 10.
5. Kneyber MCJ, de Luca D, Calderini E, Jarreau PH, Javouhey E, Lopez-Herce J, *et al*. Recommendations for mechanical ventilation of critically ill children from the Paediatric Mechanical Ventilation Consensus Conference (PEMVECC). Intensive Care Med.,2017:43(12):1764-80.
6. Turner DA, Arnold JH. Insights in pediatric ventilation: timing of intubation, ventilatory strategies, and weaning. Curr Opin Crit Care,2007:13(1):57-63.
7. GS, TVR, CA BF, MPJ. OUTCOME OF CHILDREN TREATED WITH INVASIVE MECHANICAL VENTILATION IN PICU IN A TERTIARY CARE CENTRE, KERALA. J Evol Med Dent Sci.,2018:7(19):2342-6.
8. Carvalho WB de. Mechanical ventilation in children. J Pediatr (Rio J),1998:74(7):113-24.
9. Rsovac S, Milosevic K, Nestorovic B, Nikolic A. Complications of Mechanical Ventilation in Pediatric Patients in Serbia. Adv Clin Exp Med.,2014:23(1):57-61.

10. Benjamin PK, Thompson JE, O'Rourke PP. Complications of mechanical ventilation in a children's hospital multidisciplinary intensive care unit. Respir Care,1990:35(9):873-8.
11. Singh. Clinical Profile and Outcome of Acute Respiratory Failure in Children: A Prospective Study in a Tertiary Care Hospital. Int J Clin Pediatr, 2014.
12. Traiber C, Piva JP, Fritsher CC, Garcia PCR, Lago PM, Trotta EA, *et al*. Profile and consequences of children requiring prolonged mechanical ventilation in three Brazilian pediatric intensive care units. Pediatr Crit Care Med., 2009.
13. Bateman ST, Lacroix J, Boven K, Forbes P, Barton R, Thomas NJ, *et al*. Anemia, Blood Loss, and Blood Transfusions in North American Children in the Intensive Care Unit. Am J Respir Crit Care Med.,2008:178(1):26-33.
14. Stockwell DC, Slonim AD. Dissecting Sepsis Outcomes in Critically Ill Children. Am J Respir Crit Care Med.,2005:171(4):297-8.
15. Suka M, Yoshida K, Uno H, Takezawa J. Incidence and Outcomes of Ventilator-Associated Pneumonia in Japanese Intensive Care Units: The Japanese Nosocomial Infection Surveillance System. Infect Control Hosp Epidemiol,2007:28(3):307-13.
16. Costa G de A, Delgado AF, Ferraro A, Okay TS. Application of the Pediatric Risk of Mortality Score (PRISM) score and determination of mortality risk factors in a tertiary pediatric intensive care unit. Clinics.,2010:65(11):1087-92.
17. Balakrishnan G, Aitchison T, Hallworth D, Morton NS. Prospective evaluation of the Paediatric Risk of Mortality (PRISM) score. Arch Dis Child,1992:67(2):196-200.
18. Aly H, Badawy M, El-Kholy A, Nabil R, Mohamed A. Randomized, Controlled Trial on Tracheal Colonization of Ventilated Infants: Can Gravity Prevent Ventilator-Associated Pneumonia? Pediatrics,2008:122(4):770-4.
19. Souza N de, Carvalho WB de. Complicações da intubação traqueal em pediatria. Rev Assoc Med Bras,2009:55(6):646-50.