

ORIGINAL RESEARCH

Clinical and Etiological Profile of Mechanically Ventilated Patients Admitted in Paediatric Intensive Care at Tertiary Care Centre

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ABSTRACT

Background: Mechanical Ventilation (MV) is frequently used as one of the most frequent life-supportive technology in Pediatric Intensive Care Units (PICUs). The present study was undertaken to assess the clinical and etiological profile and outcome of mechanically ventilated patients admitted in PICU at Tertiary Care Centre.

Methods: A total 120 children of age >30 days and <12 years, who were ventilated in PICU mechanically from September 2019 to October 2021 were included in the study. The demographic, clinical and etiological profile, complications and outcomes (Extubated and died) were recorded.

Results: The mean age of patients was 3.32 ± 1.19 years with male predominance (55%). The commonest cause for intubation was circulatory failure (42.5%) and commonest clinical diagnosis was septic shock (27.5%). In 71.67% patients rapid sequence intubation (RSI) was used. Size of ET was appropriate in 92.5% and type of ET was uncuffed in 90%. 13(10.83%) patients required reintubation and 9(7.5%) patients done tracheostomy. Out of 120 patients, 21(17.5%) required T piece, SIMV in 9.17%, CPAP in 5.83% and no weaning methods in 67.5%. Majority of patients required inotropes (80.83%) and raised intracranial pressure (ICP) was seen in 27(22.5%) patients. Nosocomial pneumonia (15%) and obstructive emphysema (15%) were the commonest complications. 25(20.83%) patients had culture positivity and *K. Pneumoniae* (6.67%) was the commonest organism isolated, among 25 cases, 7 had multiple drug resistance (MDR) (28%). Majority of patients died (62.50%) while 37.5% patients extubated.

Conclusion: Mortality was high, hence the patients requiring MV require better primary care availability at periphery so that they can be managed well at tertiary level centres. Also better infection control and respiratory disease control are required.

Keywords: Mechanical Ventilation; Pediatric Intensive Care Units; Intubation; Tracheostomy; Inotropes; Nosocomial pneumonia

INTRODUCTION

Ventilatory support is an essential and a common form of therapy in Pediatric Critical Care Unit. In recent years, this modality has evolved into a highly specialized discipline [1]. The term mechanical ventilation (MV) refers to various artificial means used to support ventilation and oxygenation [2]. It is a lifesaving intervention accounts for 30-64% of PICU

management [3]. However the objectives of MV in the pediatric patient includes improved pulmonary gas exchange; relief of respiratory distress; management of pulmonary mechanisms; provide airway protection and provide general cardiopulmonary support [4]. The primary indication for institution of assisted ventilation is respiratory failure [5] and other indications are cardiovascular dysfunction [6] neurological and neuromuscular disorders [7]. Mechanical ventilation may also be provided in disorders with raised intracranial pressure to optimally ventilate the child [8]. Moreover MV is one of the major supportive modalities used in critical care all over the world, but this treatment modality is being used in very limited number of sick children in few government tertiary care medical centers. Despite the limitations of a greater percentage of critically sick children arriving late, the overall survival is 49% [9].

Although, MV has its own complications, which are usually due to prolonged ventilatory support. The outcome depends on various confounding factors. Complications of ventilation as a complex and invasive technology, MV is fraught with numerous adverse outcomes, both iatrogenic and unavoidable [10]. Indications and outcome about the children receiving MV in rural set up are lacking [11-13]. Hence the present study was undertaken to study the clinical and etiological profile, outcome of MV patients admitted in PICU at tertiary care centre. Also assess complications, microbiological profile, and antibiotic sensitivity in culture positive sepsis in patients on MV.

MATERIALS AND METHODS

After obtaining Institutional Ethical Committee approval and written informed consent from children's parents/ guardian, the present study was conducted in 120 children more than 30 days and less than 12 years and who were ventilated in PICU mechanically at tertiary care hospital and a rural medical college in Eastern Maharashtra from September 2019 to October 2021. Consecutive sampling technique was used to gather the sample. Children ventilated for less than 12 hours and children who were ventilated outside the hospital and referred for further care were excluded from the study. Patients whose parents did not give written informed consent were also excluded from the study.

The demographic data of the patient, clinical and etiological profile, lab investigation reports, cardiopulmonary status prior to intubation (heart rate, respiratory rate, blood pressure, oxygen saturation), diagnosis of illness, intubation details (indication for MV, Rapid sequence intubation (RSI) used for intubation, Size of ET, Type of ET, re-intubation), need for inotropes, ventilation details, duration of ventilation and weaning methods, requirement for re-intubation within 48 hours after extubation, complications, culture positivity, Multi Drug Resistance (MDR) in culture positive isolates and outcomes (Extubated and died) were recorded.

STATISTICAL ANALYSIS

Data was collected using a semi-structured pretested questionnaire, data Collected was entered in Microsoft Excel. Data was represented in frequencies and percentages, charts and graphs. Mean and standard deviation used for quantitative variables. Appropriate statistical tests were applied using SPSS software version 21 for analysis. Chi square test was used for association. Other statistical tests were used as per study requirements. P value < 0.05 was taken as statistical significance.

OBSERVATIONS AND RESULTS

A total 120 children of age between 1 month to 12 years admitted in PICU and required MV during the study period were included as study population. The majority of patients in the

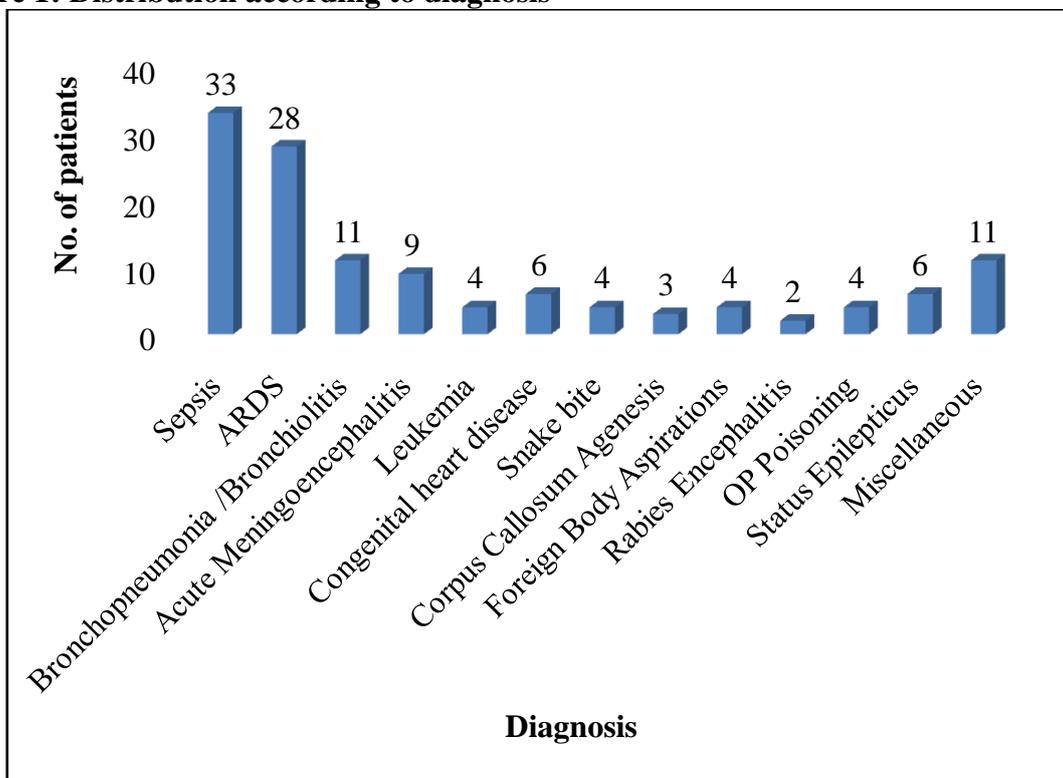
age group of 4-6 years (34.16%) followed by 1-3 years (27.5%). The mean age of patients was 3.32 ± 1.19 years with male predominance (55%) as shown in table 1.

Table 1: Demographic profile of the patients

| Demographic data | | Frequency | Percentage |
|------------------|-------------------|-----------|------------|
| Age group | 1 month to 1 year | 21 | 17.50 |
| | 1 to 3 year | 33 | 27.50 |
| | 4 to 6 year | 41 | 34.16 |
| | 7 to 9 year | 14 | 11.67 |
| | 10 to 12 year | 11 | 9.17 |
| Gender | Male | 66 | 55.0% |
| | Female | 54 | 45.0% |

The majority of patients diagnosed as sepsis (27.5%) followed by ARDS (23.33%), bronchopneumonia (9.17%) and miscellaneous (9.17%) as depicted in figure 1.

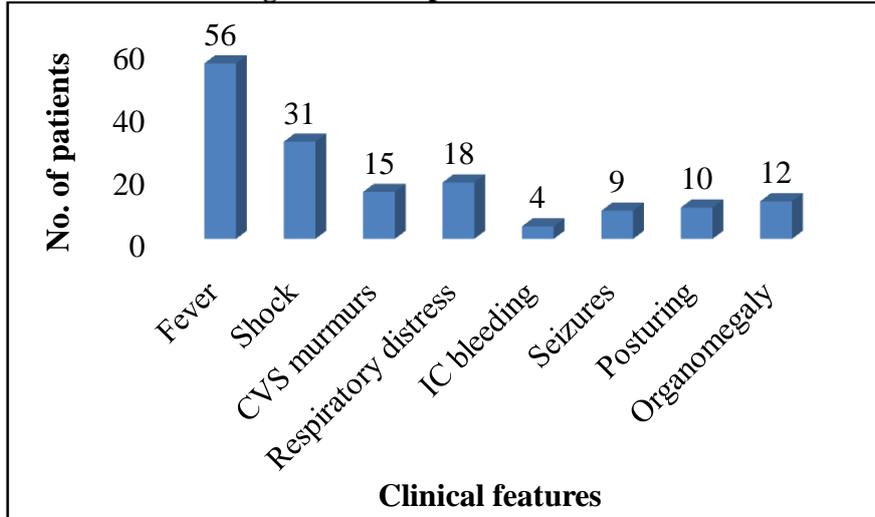
Figure 1: Distribution according to diagnosis



Most of the patients presented with fever (46.67%) followed by shock (25.83%), respiratory distress (15%), CVS murmurs (12.5%), organomegaly (10%) as shown in figure 2.

Maximum patients had circulatory indication for MV(42.5%) followed by neurological (26.67%), respiratory (17.5%), Neurological + Circulatory (7.5%) and respiratory + neurological (5.83%).However, in majority of patients rapid sequence intubation (RSI) used (71.67%) followed by sedation / analgesic (28.33%).

Figure2: Distribution according to clinical profile



It was observed that majority of patients size of ET was appropriate (92.5%) and type of ET was uncuffed (90%). 13 (10.83%) patients required reintubation, (Table 2).9 (7.5%) patients done tracheostomy.

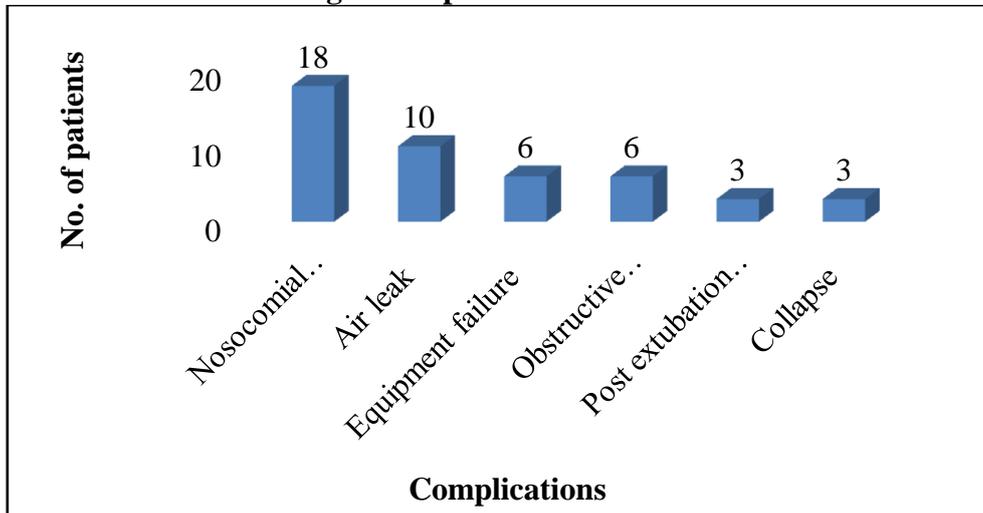
Table 2: Distribution according to ET parameters

| Parameter | | Frequency | Percentage |
|--------------|-------------|-----------|------------|
| Size of ET | Appropriate | 111 | 92.50 |
| | Small | 07 | 5.83 |
| | Big | 02 | 1.67 |
| Type of ET | Cuffed | 12 | 10.00 |
| | Uncuffed | 108 | 90.00 |
| Reintubation | Yes | 13 | 10.83 |
| | No | 107 | 89.17 |

Out of 120 patients, 21 (17.5%) patients required T piece, SIMV in 9.17% (11 cases), CPAP in 5.83% (7 cases) and no weaning methods in 67.5% patients (81 cases).The majority of patients required inotropes (80.83%) and raised intracranial pressure (ICP) was seen in 27 (22.5%) patients.

Most of the patients had nosocomial pneumonia (15%), obstructive emphysema (15%), air leak (8.33%), equipment failure (5%) and collapse (2.5%) as depicted in figure 3.

Figure 3: Distribution according to complications



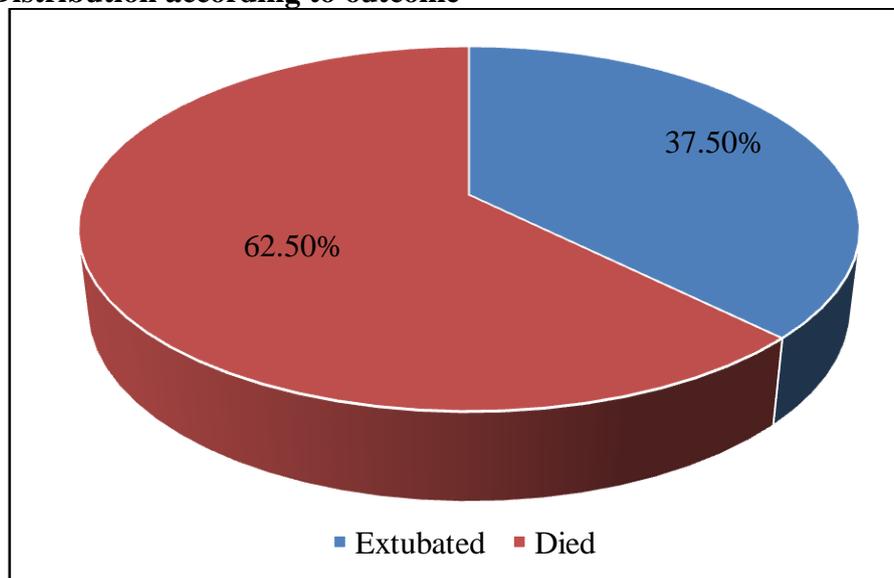
Out of 120, 25 (20.83%) of patients had culture positivity. Among culture positive patients' majority of patients were having K. Pneumoniae (6.67%) followed by E. coli (5.83%). Among 25 cases with organisms isolated, 7 cases had multiple drug resistance on antibiotic sensitivity testing (28%) and details are shown in table 3.

Table 3: Culture positivity and MDR in culture positive isolates

| Organisms isolated | Culture positivity | MDR isolates |
|------------------------|--------------------|----------------|
| K Pneumoniae | 08 (6.67%) | 2 / 8 (25%) |
| E coli | 07 (5.83%) | 1 / 7 (14.29%) |
| P Aeruginosa | 05 (4.17%) | 1 / 5 (20.0%) |
| Staph Aureus | 04 (3.33%) | 2 / 4 (50.0%) |
| AcinetobacterBaumannii | 01 (0.83%) | 1 / 1 (100.0%) |

The outcome of the study is depicted in figure 4, which showed that the majority of patients were died (75 cases - 62.50%) while 37.5% patients extubated.

Figure 4: Distribution according to outcome



DISCUSSION

Though mechanical ventilation is the standard of care, our hospital being a Government hospital and a tertiary referral centre, many critically ill children with need for ventilation are being referred to here. Pediatric intensive care unit is a setup where critically ill children are admitted needing the organ support for various systems. In the present study, total 120 patients of age ranged from 1 month to 12 years admitted in PICU were studied to assess the clinical and etiological profile and the outcome of MV. Majority of patients were in the age group of 4-6 years (34.16%) with mean age of 3.32 ± 1.19 years which is comparable with the study done by Mukhtar B et al [14] and Sahoo B et al [15]. Most of the patients were male children with male to female ratio of 1.2:1. Similar results were reported in other studies [14-17]. Reason might be either female children have lesser chance of getting critically ill in south Asia or chances of critically ill female babies reaching the tertiary care facility are less as compared to male babies. More research is required to look into this parameter.

The commonest cause for intubation was circulatory failure (42.5%) and the commonest clinical diagnosis was septic shock (27.5%) which is correlated with the Sahoo B et al [15] and Gadappa SM et al [18] study. Also studies conducted by Da Silva et al [19] and Shirley GFA [20] observed respiratory failure was the commonest cause of initiation of MV. Unlike other studies, [11, 14] where neurological illness was the most common reason for MV in

PICUs. The most likely explanation for this change in pattern was the increased use of non-invasive ventilation through high-flow nasal cannula and Bi-PAP in the early phases of acute respiratory illness like bronchiolitis and pneumonia as initial mode of respiratory support.

Rapid Sequence intubation (RSI) was performed in 71.67% of the study population compared to routine RSI protocol used in the study by Da Silva et al [19]. The size of ET was appropriate in 92.5% of cases and type of ET was uncuffed in 90%. It was observed that 13 (10.83%) patients required reintubation. 9 (7.5%) patients were done tracheostomy which is comparable with the Sahoo B et al study [15]. The distribution of patients according to weaning showed that 21 (17.5%) patients required T piece, SIMV in 9.17%, CPAP in 5.83% and no methods in 67.5% patients. Most of the patients required inotropes (80.83%) and raised ICP was seen in 22.5% patients.

Complications are common among mechanically ventilated children in PICU. In current study, complication rate was 38.33%. Sahoo B et al [15] reported complication rate was 10.8% as compared to 9.4% reported by Mukhtar B et al [14]. The ventilator associated pneumonia (VAP) (15%) was identified as the commonest complication in the study which is much lower as compared to the previous studies [19, 21, and 22].

Out of 120, 25 (20.83%) of patients had culture positivity. Among culture positive patients' majority of patients were having K. Pneumoniae (6.67%) followed by E. Coli (5.83%), P Aeruginosa (4.17%), Staph Aureus (3.33%) and AcinetobacterBaumannii (0.83%). Gadappa et al reported culture positivity in 26.9% patients with Klebsiellapneumoniae, Pseudomonas aeruginosa and MRSA being most common organisms isolated [18].

In present study most of the patients were died (62.50%) which is comparable with the study conducted by Gadappa SM et al (73%) [18]. A mortality rate of as high as 58.3% was observed by Kendirli[23] in contrast to as low as 4.5% observed by Tan et al [24]. In developed countries, the overall mortality rates in mechanically ventilated patients in PICUs was less than 2% [25]. There are several reasons for this major difference in the mortality rate of MV children. Several advantages including higher number of postoperative cases in their PICUs, trained staff, availability of respiratory therapist for ventilatory management, early presentation of illness are known for established PICUs in developed countries [14]. We have several disadvantages including lack of respiratory therapist services, lack of education and training of MV as well as delayed presentation with multiorgan dysfunction syndrome. 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 [26]. As we gain experience in the ventilation our complications rate and mortality related to mechanical ventilation would also decrease.

CONCLUSION

In the present study the mean age of patients requiring MV was 3.32 years, thus giving the importance of availability of advanced PICUs at secondary and tertiary level care units to prevent mortality and morbidity for under 5 years children. Sepsis and ARDS were the most common causes of requirement of MV which gives idea that there is requirement of better infection control and respiratory diseases control in under 5 years children. Nosocomial pneumonia was the common complication, thus we conclude that there is a need for the better infection control required at hospitals. Mortality noted in present study was high, hence the patients requiring MV require better primary care availability at periphery so that they can be managed well at tertiary level centres.

LIMITATIONS AND RECOMMENDATIONS

This was a single centered study in a limited time period. We had limitations of resources and samples were collected from a tertiary level centre. This was not a true representative of the population in general as there can be other cases at private institutes which were not included in our study. We recommend a multicentric prospective study funded by research agencies to evaluate the patients requiring MV. Also, we recommend better vaccination coverage, better availability of primary care services to prevent and manage vaccine preventable diseases at periphery to prevent severe disease requiring MV at tertiary care Centre.

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