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Original Article

COMPLICATIONS OF MECHANICAL VENTILATION IN CHILDREN UP TO 12 Y OF AGE

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ABSTRACT

Objective: Mechanical ventilation has been proven to be lifesaving and has significantly reduced mortality in the pediatric population. Despite its life-saving advantages, mechanical ventilation is associated with complications. The study aimed to assess the complications of mechanical ventilation in children up to 12 y of age admitted to the intensive care unit.

Methods: The present descriptive, observational, cross-sectional study was conducted on 165 children aged between 0 to 12 y, who were mechanically ventilated for>48 h. Patients were observed daily until the desired result was achieved and were checked to look for complications or negative effects of mechanical ventilation.

Results: The majority of subjects belonged to<1 mo of age (77.58%) whereas the maximum number of patients were male (64.24%). In 77.58% of patients, the indication for mechanical ventilation was respiratory failure. The duration of ventilation in 62.43% of patients was>7 d. A total of n=62 (37.58%) patients had ventilator-associated complications. The most common complication was ventilator-associated pneumonia (n=30, 48.38%). The mean hospital stay was found to be 22.88±7.96 d. Whereas the mean hospital stay in patients without complications was significantly less compared to patients with complications (18.57±10.09 d vs 27.19±5.83 d, P=0.00015). The mortality rate was found to be 47.27%.

Conclusion: Respiratory cause was the most common indication for mechanical ventilation. The most common complication was ventilator-associated pneumonia. The subjects with complications had prolonged hospital stays.

Keywords: Mechanical ventilation, Pediatric intensive care, Ventilator associated pneumonia

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INTRODUCTION

A critical and frequent kind of therapy in the intensive care unit (ICU) is ventilator support. This modality has developed into a very specialized field in recent y. Different artificial techniques used to promote ventilation and oxygenation are referred to as mechanical ventilation. Mechanical ventilation aims to enhance patient-ventilator synchronization, provide appropriate oxygenation and optimal alveolar ventilation, minimize alveolar excess distension, maintain alveolar recruitment, and employ the lowest FiO2 feasible [1].

In ICU, mechanical ventilation is often employed, and more than 20% of kids need invasive ventilator assistance [2, 3]. There are many non-respiratory indications for mechanical ventilation, including neurological and neuromuscular pathology, congenital heart disease, hemodynamic shock, postoperative care, and pain management, even though respiratory disease is a major reason for invasive mechanical ventilation. When compared to clinical practice from 30 y ago, pediatric patients are presently ventilated with a reduced tidal volume and lower peak inspiratory pressure [4]. Pediatricians must be skilled in recognizing, avoiding, and treating mechanical ventilation difficulties since they happen often despite the extensive use of lung-protective breathing techniques in the pediatric population [2].

Studies examining the side effects of mechanical ventilation in children are uncommon and were mostly done before the development of protective breathing techniques for acute lung damage [5, 6]. Recent research on kids has either focused on a few problems, such as ventilator-associated pneumonia (VAP) and extubation failure (FE), or it has gathered data from previous studies on non-invasive or at-home mechanical ventilation for children [7-9]. There isn't much research that thoroughly explores mechanical ventilation complications in children and the variables that contribute to difficulties [10]. Therefore the present study was undertaken to study the complications of mechanical ventilation in children up to 12 y admitted to the intensive care unit.

MATERIALS AND METHODS

The present descriptive, observational, cross-sectional study was conducted at Rajarshee Chhatrapati Shahu Maharaj Government Medical College, Kolhapur, from 31st December 2020 to 31st March 2022 after institutional ethical committee approval. A total of 165 children aged between 0 to 12 y, who were mechanically ventilated for>48 h were included in the study. Whereas children receiving ventilation by tracheostomy, those who had received mechanical ventilation in other hospitals before admission, and patients already having chronic kidney disease, chronic liver disease, and death within 48 h of ventilation were excluded from the study.

All the patients satisfying inclusion and exclusion criteria were included in the study. Written informed consent was obtained from parents and the patient wherever necessary. Patient data regarding weight, age, sex, comorbidities, indication for mechanical ventilation, details of mechanical ventilation, and diagnosis were collected. Procedure information for each intubation and extubation event was documented for each patient. The information was gathered daily at admission from the ventilator display or ventilation flow sheet. Patients were observed daily until the desired result was achieved and were checked to look for complications or negative effects of mechanical ventilation.

After noting the total time of mechanical ventilation and hospital stays, the impact of complications with mechanical ventilation on the patient's outcome, such as an extension of the duration of mechanical ventilation or death, was examined.

Statistical analysis

Data were collected and entered into a Microsoft Excel sheet. Continuous variables were expressed in mean and standard

deviation and categorical variables were expressed in percentage and frequency by using SPSS IBM 20 version. The association between variables was assessed using the Chi-square test. P<0.05 was considered statistically significant.

RESULTS

The majority of subjects belonged to<1 month of age (77.58%) (table 1 and fig. 2).

Fig. 1: Neonatal ventilation

Table 1: Distribution of subjects according to demographical variables

Variables	Subcategories	Frequency (n)	Percentage (%)
Age (months)	<1	128	77.58
	1-6	17	10.30
	7-12	1	0.61
	13-60	13	7.88
	>60	6	3.63
Sex	Female	59	35.76
	Male	106	64.24

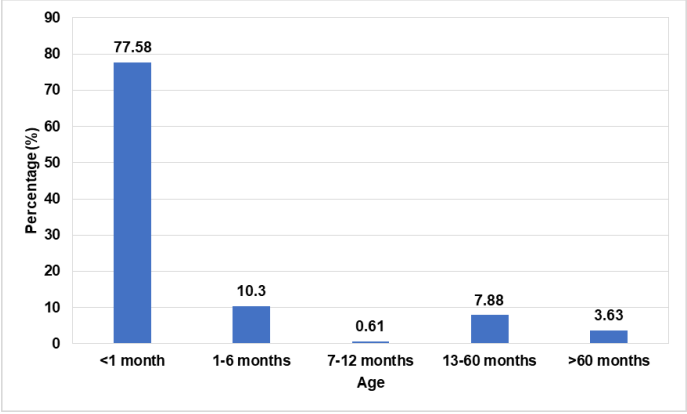

Fig. 2: Distribution of subjects according to age

In 77.58% of patients, the indication for mechanical ventilation was respiratory failure. The duration of ventilation in 62.43% of patients was>7 d. The detailed distribution of subjects according to indication and duration of ventilation is depicted in table 2.

Table 2: Distribution of subjects according to indication and duration of ventilation

Variables	Subcategories	Frequency (n)	Percentage (%)
Indications	Cardiovascular failure	17	10.30
	Neuromuscular disease	17	10.30
	Respiratory cause	128	77.58
	Other	3	1.82
Duration of ventilation (d)	>2-3	47	28.48
	4-7	15	9.09
	>7	103	62.43

A total of n=62 (37.58%) patients had ventilator-associated complications. The most common complication was ventilator-associated pneumonia (n=30, 48.38%). A detailed illustration of complications is shown in table 3 and fig. 3.

Table 3: Distribution of subjects according to complications

Complication	Frequency (n)	Percentage (%)
Pneumothorax	5	8.06
Ventilator-associated pneumonia	30	48.38
Collapse	18	29.03
Accidental extubation	5	8.06
Extubation failure	2	3.22
Perioral tissue damage	2	3.22
Total	62	100

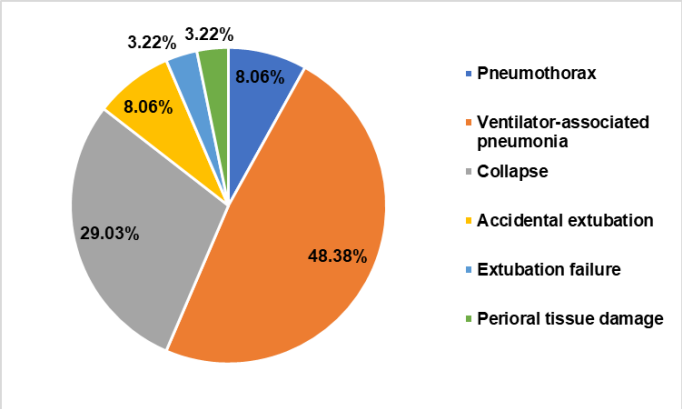

Fig. 3: Distribution of subjects according to complications

The mean hospital stay was found to be 22.88±7.96 d. Whereas the mean hospital stay in patients without complications was significantly less compared to patients with complications (18.57±10.09 d vs 27.19±5.83 d, P=0.00015). The mortality rate was found to be 47.27%.

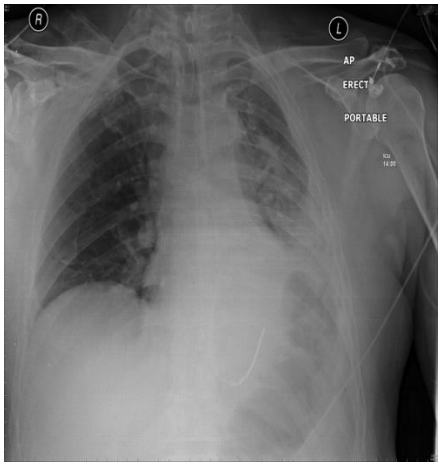

Fig. 4: Chest X-ray showing ventilator-associated pneumonia

DISCUSSION

The study was conducted to assess the complications of mechanical ventilation in children up to 12 y of age, admitted to the intensive care unit. We included children on mechanical ventilation for>48 h. Our findings suggested that the use of mechanical ventilation was more common in the subjects with 0-1 months of age. This could be due to low birth weight, preterm birth, sepsis, hypoglycemia, birth asphyxia, pulmonary haemorrhage, and meningitis in newborns. Furthermore, in our study, male predominance was seen (64.24%). The male predominance may be due to, as the majority of the study population being newborns; thus, the effect of testosterone can cause reduced surfactant production [11]. Another reason for male predominance may be in countries such as India where male is the gender of choice and receive extra care. These findings are comparable with previous reports [7, 12, 13].

In this study, the majority of patients were preterm newborns and respiratory distress syndrome was the most common diagnosis. The most common indication in our study was impending respiratory failure due to respiratory distress. In the present study, 77.58% of children were seen with respiratory failure of mechanical ventilation, followed by 10.30% with cardiovascular failure and neuro-muscular disease, respectively. Furthermore, 62.43%, 28.48%, and 9.09% of subjects had a duration of ventilation>7 d, 2-3 d, and 4-7 d respectively. In the study of Sathyadith N *et al.* the most common indication for ventilation was respiratory failure and decompensated shock. In their study, the mean duration of ventilation was 3.4±2.5 d while 40% of cases had ventilation support for 3-7 d [14]. In the study of Abdelrazic MI *et al.*, mechanical ventilation was indicated for respiratory failure secondary to either respiratory causes in 91(36.2%) infants, for non-respiratory causes in 135 (53.7%) infants, or for both respiratory and non-respiratory causes in 25(9.9%) infants. In their study the mean duration for mechanical ventilation was 4.1±2.6 d, ranging from 1 to 17 d [12]. The difference in the results may be due to differences in sample characteristics, study setting, presence of comorbidities, etc.

In the present study, the complication rate was found to be 37.58%. The complications including ventilator-associated pneumonia (48.38%), collapse (29.03%), pneumothorax (8.06%), accidental extubation (8.06%), extubation failure (3.22%), and perioral tissue damage (3.22%). Similar rates of complications were shown in previous reports [14-16]. However, complications vary in these reports, the possible reason may be the type of mechanical ventilation device used, study population, and duration of mechanical ventilation.

In our study average hospital stay was 22.88±7.96 d, the average hospital stay in patients with complications was 27.19±5.83 d, and without complications was 18.57±10.09 d; the difference was statistically significant (P=0.00015). This suggests that hospital stay was prolonged in patients with mechanical ventilation with complications as compared to those without complications. A similar trend of hospital stay is reported in the study of Bhori NS *et al.* [16]. Furthermore, in our study, the mortality was found to be 47.27%.

Various studies have reported mortality rates ranging from 12.5% to 58.3% [15-19]. ICUs with higher mortality may be caring for patients with more severe illnesses and vice versa. However, lower mortality rates do not necessarily translate into better long-term outcomes. In developed countries, the overall mortality rates in mechanically ventilated patients in ICUs were<2% [20].

CONCLUSION

In this study, ventilator-associated pneumonia and respiratory collapse were the most common complications in the study subjects. Therefore, health education and training of staff regarding aseptic precaution, equipment care, and monitoring to prevent or detect complications at the earliest is necessary so that timely intervention and mechanical ventilation can reduce the duration of mechanical ventilation and hospital stay and thus improve the outcome.

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Nil

AUTHORS CONTRIBUTIONS

All the authors have contributed equally

CONFLICTS OF INTERESTS

Declared none

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