Pediatric Oncall Journal

DOI: https://doi.org/10.7199/ped.oncall.2026.11

ORIGINAL ARTICLE

EXTUBATION FAILURE IN CHILDREN: AN INSIGHT INTO INCIDENCE, ETIOLOGICAL FACTORS AND OUTCOMES

Dinesh Sukhdev Ambhore, Nusrat Rahim Inamdar, Anupama Mauskar.

Pediatric Department, HBTMC & Dr R N Cooper Hospital, Mumbai, India.

ABSTRACT

Background: Ventilatory support is an essential therapy in Paediatric Critical Care Unit. Anticipating and managing extubation failure is a challenge and depends on clinical judgment, cardio respiratory, neurological and hemodynamic status of the patient.

Aim: Analyzing the incidence, etiological factors & outcomes of extubation failure in paediatric intensive care unit.

Method: Single centric, prospective, cohort study conducted in a PICU of tertiary care hospital in Mumbai over a period of 2 years. Children of 1 month to 12 years requiring mechanical ventilation and suffering Extubation failure during their stay in PICU were included. Using predesigned Performa, their demographic, Clinical and Biochemical parameters including ABG values were recorded and analyzed with appropriate statistical tests.

Result: Total admissions in the PICU were 566, while 148 (25.14%) required mechanical ventilation and extubation failure was observed in 82 (55.41%) children. Most participants (58.5%) were 1 month to 1 year age, 56.1% were male, and 43.9% were female. Respiratory disease was the primary diagnosis for 61% of participants, while 28% had a deteriorating neurological condition, and 11% had cardiovascular disease. Extubation failure was most commonly due to inadequate gas exchange (43.9%), poor respiratory drive (41.5%), and neurological conditions (14.6%).

70.7% of participants expired, while 29.3% survived. There was no statistically significant correlation between the duration of ventilation, gender, reason for failure, biochemical parameters or co morbidities and the outcome.

A statistically significant correlation was found between MODS and the outcome.

Conclusion: The extubation failure has significant morbidity and mortality, hence anticipation and proper planning is essential to prevent extubation failure and enhance outcomes.

ARTICLE HISTORY

Received 10 September 2024

Accepted 03 October 2024

KEYWORDS

Pediatric Ventilation, Respiratory failure, Extubation readiness, Tracheostomy, failed extubation.

Introduction

Ventilatory support is an essential therapy in Paediatric Critical Care Unit. With recent advances, this modality has evolved into a highly specialized discipline. The term mechanical ventilation refers to various artificial means used to support ventilation and oxygenation.

Indications for mechanical ventilation include: 1) Respiratory distress and failures, 2) Cardiovascular dysfunctions & 3) Neurological and neuromuscular disorders.

Weaning is defined as liberation from mechanical ventilation while spontaneous breathing is allowed to assume the responsibility for effective gas exchange.[1] During weaning, the emphasis is on ways of enhancing the return of full diaphragmatic function and discontinuation of mechanical ventilation.[2] The provision of invasive respiratory support with an endotracheal tube (ETT) is a core feature of intensive care. An ETT is a conduit for mechanical ventilation and provides airway support for individuals with upper airway abnormalities. This intervention has unique features in paediatric patients due to age specific disorders, maturational differences in airway size, and the evolution of respiratory mechanics. Successful extubation rests on improvement or resolution of the condition along with other factors such as gas exchange capacity, respiratory muscle strength, laryngeal function and cough strength, nutritional status, psychological state, and dissipation of sedative and muscle relaxant effects.

The process of discontinuing invasive mechanical ventilation (IMV) involves two stages: the removal of the ventilatory support, known as weaning, and the removal of the artificial airway, defined as extubation.[3]

EXT failure is defined as the need for reintubation within 48 hours after removal of the artificial airway.

Address for Correspondance: Dinesh Sukhdev Ambhore, 304-Adhikari Niwas. HBTMC and Dr R N Cooper Hospital. Vile Parle west.

Email: drdsambhore@gmail.com

In the paediatric population, it is estimated that the failure rate ranges from 16% to 22%.[4] The choice of the ideal time for EXT is a challenge and is usually made based on clinical judgment, based on the cardio respiratory, neurological and hemodynamic status of the patient.[5] The Pediatric Acute Respiratory Distress Syndrome: Consensus (PARDS) recommends the performance of daily evaluations of EXT readiness in paediatric patients.[6] Prediction of Extubation Failure is essential, as both delayed and failed extubation have detrimental consequences.[3]

Paucity of literature on factors predicting extubation outcome in children and poor predictive value of weaning guidelines urged us to gain insight into this rather important aspect of mechanical ventilation. We planned this study in infants and children to explore factors that may predict Extubation failure. In this study, we report the clinical profile of patient, indications, complications and end results of mechanical ventilation in children who had extubation failure in our PICU. This study findings may aid changes in management protocols leading to better outcome.

Methods & Materials

It was a Single centric, Prospective, Cohort study conducted in the PICU in a Tertiary Care Hospital over a period of two years (July 2022 to June 2024) after obtaining Departmental Review Committee and Institutional Ethics Committee permission.

82 Children admitted in the PICU during the study period meeting inclusion criteria were enrolled. The parents of the participants were briefed about the study and informed consent was obtained. The patients were subjected to detailed clinical history and examination. Data was collected using a predesigned Performa.

All decisions related to patient's care were taken by the treating physicians and they were blinded to data collection and analysis procedure. The parameters collected were divided into: **(1)** Demographic data: Age, sex, weight, diagnosis on admission, indication for ventilation and duration of intubation, **(2)** Clinical parameters: Hemoglobin concentration, heart rate, spontaneous respiratory rate, blood pressure, peripheral oxygen saturation (SpO2), work of breathing, presence of cough reflex, amount and consistency of secretion, use of inotropes, use of sedation and use of dexamethasone, **(3)** Blood gas parameters (venous gases): pH, partial pressure of carbon dioxide (PCO2), bicarbonate (HCO3−), base excess (BE), lactate and **(4)** Ventilatory parameters: Ventilator mode, ventilator rate, peak inspiratory pressure (PIP), positive end-expiratory pressure (PEEP), fraction of inspired oxygen (FiO2), inspiratory time (Ti), expiratory time (Te), spontaneous breathing trial (SBT), rapid shallow breathing index (RSBI) and use of bubble CPAP following extubation. These parameters were measured pre-extubation, post-extubation (whenever necessary), and at the time of any re-intubation.

Inclusion criteria: All children between the age group of 1 month to 12 years requiring mechanical ventilation and suffering Extubation failure during their stay in PICU.

Exclusion criteria: All those patients whose parents/ guardians did not consent to participate in the study. Infants having other co-morbidities and Congenital anomalies of Respiratory or CVS or CNS or Musculoskeletal system, Preterm born infants and patients admitted with a tracheostomy in situ (Referred from another institute).

Operational Definitions:[7]

1. Blood gas parameters are pivotal in managing and understanding extubation failure in the Pediatric Intensive Care Unit (PICU).
   - Partial Pressure of Oxygen (PaO2): Indicates oxygen levels in the blood. Low PaO2 suggests poor oxygenation, often necessitating reintubation to improve oxygen delivery.
   - Partial Pressure of Carbon Dioxide (PaCO2): Reflects the adequacy of ventilation. Elevated PaCO2 points to impaired CO2 elimination, leading to respiratory acidosis and indicating the need for reintubation.
   - Arterial pH: Measures the overall acid-base balance. Abnormal pH levels (acidosis or alkalosis) reveal respiratory or metabolic imbalances that may require mechanical support to correct.
   - Bicarbonate (HCO3-): Indicates metabolic compensation for acid-base imbalances. Abnormal levels suggest issues with metabolic compensation or ongoing metabolic disturbances.
   - Oxygen Saturation (SpO2): Shows the percentage of hemoglobin saturated with oxygen. Low SpO2 levels signal inadequate oxygenation, often requiring reintubation to enhance oxygen delivery.
2. *The Multiple Organ Dysfunction Syndrome (MODS)* can be defined as the development of potentially reversible physiologic derangement involving two or more organ systems not involved in the disorder that resulted in ICU admission, and arising in the wake of a potentially life-threatening physiologic insult.

Statistical Analysis:

All the collected data was compiled in a Microsoft office Excel sheet and was analyzed. Results on continuous measurements are presented on Mean + SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. Student t test has been used to find the significance of study parameters on continuous scale while Chi-square/Fisher exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

Results and Discussion

A total of 566 admissions were there in the PICU during study period with 148 (25.14%) requiring mechanical ventilation and 82 (55.41%) cases having extubation failure, who were enrolled in the study. The participants in the study were of 1 month to 12 years of age. The average age was 29.76 (±40.98) Months. Majority of the participants, 48 (58.5%) were in the age group of < 1 Year. 46 (56.1%) participants were Male and 36 (43.9%) participants were Female. **(Table 1)**

Table 1. Ventilation requirement, Extubation failure, and Age and gender wise distribution in the participants.

Mechanical Ventilation required	**Number of Participants**	**Percentage (%)**
Yes	148	26.15
No	418	73.85
Total	566	100
Extubation outcome		
Extubation failure	82	55.41
Extubation success	66	44.59
Total	**148**	**100**
Age (Years)	**Number of Participants**	**Percentage (%)**
<1 year	48	58.5
1-5 years	19	23.2
5-12 years	15	18.3
Total	**82**	**100**
Gender		
Male	46	56.1
Female	36	43.9
Total	**82**	**100**

Majority of the participants 52 (61%) had respiratory disease as indication of Mechanical ventilation. 34 (41.5%) participants were ventilated for <7 days and 44 (53.7%) participants for 7-14 days. 81 (98.8%) participants had PCV as initial Mode of ventilation. Maximum participants 62 (75.6%) were not having any co-existing morbidity, others are as mentioned. **(Table 2)**

Table 2. Indication, Duration, Mode of Ventilation and Co-existing morbidity in the participants (n=82).

Indication for Intubation	**Number of Participants**	**Percentage (%)**
Cardiovascular disease	9	11
Deteriorating Neurological Condition	23	28
Respiratory disease	50	61
Total	**82**	**100**
Duration of Ventilation (Days)		
<7	34	41.5
7-14	44	53.7
>14	4	4.9
Total	**82**	**100**
Mode of Ventilation		
PCV	81	98.8
SIMV	1	1.2
Total	**82**	**100**
Co-existing morbidity	**Number of Participants**	**Percentage(%)**
Nutritional Anemia	5	6.1
Cardiac Disease (2ASD, 1VSD)	3	3.6
Tuberculosis (CNS, TBM, DTB)	3	3.6

Indication for Intubation	Number of Participants	Percentage (%)
Cerebral Palsy	1	1.2
Failure to thrive	1	1.2
GDD	1	1.2
Glycogen Storage Disorder	1	1.2
KARS 1 gene mutation	1	1.2
Pontine Glioma	1	1.2
Temporal epilepsy	1	1.2
No co morbidity	62	75.6
Total	**82**	**100**

43 (52.4%) participants had oxygen saturation <92% on admission while 31 (37.8%) participants had oxygen saturation 92%-95%. Only 8 (9.8%) participants had oxygen saturation of >95%.

The ABG parameters of study participants at pre extubation, post extubation and at re-intubation are mentioned in **Table 3**.

Table 3. Pre Extubation, Post Extubation and Reintubation blood gas parameters of participants (n=82).

PRE EXTUBATION		
PH	**Number of Participants**	**Percentage(%)**
7.35-7.45	78	95.1
>7.45	4	4.9
PCO2 mmHg	**Number of Participants**	**Percentage(%)**
<32	26	31.7
32-48	56	68.3
PCO2 mmHg	**Number of Participants**	**Percentage(%)**
<83	3	3.7
83-108	42	51.2
>108	37	45.1
HCO3 mmol/L	**Number of Participants**	**Percentage(%)**
<22	1	1.2
22-26	81	98.8
<7.35	82	100
PCO2 mmHg	**Number of Participants**	**Percentage(%)**
32-48	37	45.1
>48	45	54.9
PO2 mmHg	**Number of Participants**	**Percentage(%)**
<83	28	34.1
83-108	52	63.4
>108	2	2.4
HCO3 mmol/L	**Number of Participants**	**Percentage(%)**
<22	82	100
7.35-7.45	70	85.4
>7.45	12	14.6
PCO2 mmHg	**Number of Participants**	**Percentage(%)**
<32	12	14.6
32-48	69	84.1
48	1	1.2
PO2 mmHg	**Number of Participants**	**Percentage(%)**
<83	4	4.9

PRE EXTUBATION		
PH	**Number of Participants**	**Percentage(%)**
83-108	53	64.6
>108	25	30.5
HCO3 mmol/L	**Number of Participants**	**Percentage(%)**
<22	3	3.7
22-26	69	84.1
>26	10	12.2

At pre extubation Mean PH was 7.39 ± 0.04. Mean PCO2 was 35.67 ± 7.18 mmHg. Mean PO2 was 113.51 ± 29.60 mmHg. Mean PCO2 was 23.46 ± 0.58 mmol/L. At post-extubation, Mean PH was 7.23 ± 0.04. Mean PCO2 was 47.78 ± 6.16 mmHg. Mean PO2 was 86.10 ± 13.23 mmHg. Mean HCO3 was 17.66 ± 1.14 mmol/L.

At reintubation, Mean PH was 7.40 ± 0.07. Mean PCO2 was 38.73 ± 5.44 mmHg. Mean PO2 was 105.62 ± 19.95 mmHg. Mean HCO3 was 24.05 ± 1.39 mmol/L.

SIMV was used in majority i.e. 79 (96.3%) participants as weaning method while CPAP was used in 3(3.7%) participants.

Inadequate Gas Exchange was commonest cause of extubation failure in 36 (43.9%) participants followed by Poor Respiratory Drive in 34 (41.5%) participants and lastly deteriorating neurological condition in 12 (14.6%) participants.

The Liver enzymes and Renal Function tests values were deranged in few participants.

5 (6.1%) participants had SGOT value of > 35 U/L. 44 (53.7%) participants had SGPT value in between 40-80 U/L & 17 (20.7%) participants had >80 U/L. 73 (89%) participants had BUN value <20 mg/dl & 9 (11%) participants had >18 mg/dl. 48 (58.54%) participants had creatinine value <1 mg/dl & 34 (41.46%) participants had >1 mg/dl.

69 (84.1%) participants didn't had any complications remaining had Ventilator Associated Pneumonia in 5 patients, Lung Collapse in 3 patients, Bed Sores in 2 patients, Pneumothorax in 2 patients and Respiratory Failure in 1 patient.

58 (70.7%) participants expired & 24 (29.3%) participants survived.

Majority of the participant had septic shock; detailed diagnosis is mentioned in **Table 4**.

Table 4. Diagnosis of the study participants.

System	Diagnosis	Number of Participants	Percentage(%)
Cardio Vascular System	Viral Myocarditis	5	6.10
	Cardiogenic Shock with ARDS	1	1.22
Metabolic disorders	Inborn Errors of Metabolism	1	1.22
	Glycogen Storage Disorder	1	1.22
	Diabetic Ketoacidosis	1	1.22
Infective	Dengue with ARDS	2	2.44
	Infantile Dengue	1	1.22
	Diabetic Ketoacidosis	1	1.22
	LONS	4	4.88
	EONS	1	1.22
	Arthritis	1	1.22
	AGE with Septic Shock	5	6.10
Respiratory System	LRTI with Septic Shock	8	9.76
	LRTI with WALRI	2	2.44
	LRTI with MODS	1	1.22
	LRTI with ARDS	4	4.88
	LRTI with VSD	1	1.22
	Bronchopneumonia	1	1.22
	Bronchopneumonia with ARDS	4	4.88
	AGE with Septic Shock	5	6.10
	Bronchopneumonia with MODS	2	2.44

System	Diagnosis	Number of Participants	Percentage(%)
Respiratory System	Viral Pneumonia with ARDS	3	3.66
	Viral Pneumonia with Septic shock	1	1.22
	RDS with Birth Asphyxia	2	2.44
	RDS with Septic shock	1	1.22
	Aspiration Pneumonia	1	1.22
	AGE with Septic Shock	5	6.10
	Meconium aspiration syndrome	2	2.44
	Pleural effusion	1	1.22
Central Nervous System	Viral Encephalitis	5	6.10
	ADEM	2	2.44
	Tuberculosis	5	6.10
	Meningoencephalitis	1	1.22
	Meningitis	1	1.22
	Seizure disorder	2	2.44
	Status epilepticus	5	6.10
	Hypoxic ischemic injury	1	1.22
	Global developmental delay	1	1.22
	Pontine glioma	1	1.22
	Leucoencephalopathy	1	1.22
	Total	**82**	**100.00**

There is statistically no significant correlation between gender (p value-0.215), Duration of Ventilation (p value-0.322) and reason of extubation failure (p value-0.342) & outcome.

There is statistically no significant correlation between co-morbidities & outcome.

There is statistically significant correlation between MODS & outcome and the p value is 0.008 (at 5% level of significant which is less than 0.05). **(Table 5)**

Table 5. Co-relation between Co-existing morbidity & MODS with outcome in the study participants.

Co-existing morbidity		Outcome		Total	P value
		Expired	**Survived**		0.08
Cardiac Disease	Count	2	1	3	
	%	66.70%	33.30%	100.00%	
Cerebral Palsy	Count	0	1	1	
	%	0.00%	100.00%	100.00%	
Failure to thrive	Count	0	1	1	
	%	0.00%	100.00%	100.00%	
GDD	Count	1	0	1	
	%	100.00%	0.00%	100.00%	
Glycogen Storage Disorder	Count	1	0	1	
	%	100.00%	0.00%	100.00%	
KARS1gene mutation	Count	0	1	1	
	%	0.00%	100.00%	100.00%	
Nutritional Anemia	Count	2	3	5	
	%	40.00%	60.00%	100.00%	
Pontine Glioma	Count	0	1	1	
	%	0.00%	100.00%	100.00%	

Co-existing morbidity		Outcome		Total	P value
		Expired	Survived		0.08
Seizure Disorder	Count	1	1	2	
	%	50.00%	50.00%	100.00%	
Temporal lobe epilepsy	Count	0	1	1	
	%	0.00%	100.00%	100.00%	
Tuberculosis	Count	2	1	3	
	%	66.70%	33.30%	100.00%	
No Comorbidity	Count	49	13	62	
	%	79.00%	21.00%	100.00%	
Total	Count	58	24	82	
	%	70.70%	29.30%	100.00%	
MODS		**Outcome**		**Total**	**P value**
		Expired	**Survived**		0.008
Present	Count	14	0	14	
	%	100.00%	0.00%	100.00%	
Absent	Count	44	24	68	
	%	64.70%	35.30%	100.00%	
Total	**Count**	**58**	**24**	**82**	
	%	**70.70%**	**29.30%**	**100.00%**	

Discussion

Extubation failure is a skilled and challenging task in PICU. In pediatric patients, extubation failure is associated with increased intensive care unit (ICU) stay, longer IMV time and, consequently, the need for tracheostomy.[8,9,10] It is reason for a higher cost for the treatment of the patient.[11] In addition, extubation failure also increases risk of mortality.[12,13,14] It is essential to know the occurrence of such events and possible risk factors so as to plan strategies to prevent and/or minimize them and improve outcome.

We observed that 25.14% of total PICU admissions required mechanical ventilation.

These findings were similar to the study by Vishnu Vardhan Kodicherla et al with 21.31% participants requiring mechanical ventilation.[15]

Extubation failure was observed in 82 (55.41%) patients. The findings were similar to the study by Amarjyoti Hazarika et al with extubation failure seen in 62.5% participants.[16]

Majority of the participants, 48 (58.5%) were in the age group of <1 Year.

These findings were similar to the study by Stephen C. Kurachek et al and Asaad G. Beshish et al with majority of participants 46.1% and 83.3% being in the age group of <1 year respectively.[17,18] The findings were similar to the study conducted by Vishnu Vardhan Kodicherla et al having majority of participants 28 (71.79%) participants of <2 years of age.[15]

46 (56.1%) participants were Male and 36 (43.9%) participants were Female.

These findings were similar to the study conducted by Asaad G. Beshish et al, 143 (55.6%) participants were Male and 114 (44.4%) participants were Female.[18] In another study by Punkaj Gupta et al, 56% participants were Male and 44% participants were Female.[19]

Maximum 62 (75.6%) participants were not having any co-existing morbidity. Our study findings could not be compared with the other studies as we have excluded prematurity & musculoskeletal disorders.

The study by M-C F Kilba et al, 6 (28.6%) participants were premature, 7 (33.3%) participants had Genetic syndrome or dysmorphology, 2 (9.5%) participants had Chronic lung disease, 5 (23.8%) participants had HIV exposure, 1 (4.8%) participant had Neuromuscular disease & 1 (4.8%) participant had Chronic kidney disease.[20]

Majority 52 (61%) participants had respiratory disease as indication of mechanical ventilation, 23 (28%) participants had Deteriorating Neurological Condition & 9 (11%) participants had cardiovascular disease. The findings of the study were similar to the study by M-C F Kilba et al in which 7 (33.3%) participants had Respiratory distress/failure, 5 (23.8%) participants had Cardiovascular instability, 3 (14.3%) participants had Neurological condition & post-operative in 7 (33.3%) participants.[20] But the findings were not similar to study by Stephen C. Kurachek et al in which 15.9% participants had Respiratory distress/failure, 33.1% participants had Cardiovascular instability, 13.1% participants had Neurological condition & oncologic cause in 3.1% participants.[17] This variation in indication for mechanical ventilation could be because of epidemiological differences.

The most common reason of extubation failure was Inadequate Gas Exchange in 36 (43.9%) participants followed by Poor Respiratory Drive in 34 (41.5%) participants, and deteriorating neurological condition

in 12 (14.6%) participants.

The findings were in accordance with the study by Steven D. Baisch et al in which the reason of extubation failure was multifactorial in 42 (32.31%) participants, Upper airway obstruction in 29 (22.31%) participants, Pulmonary insufficiency in 20 (15.38%) participants, Cardiac dysfunction in 14 (10.77%) participants, Neurological impairment in 13 (10%) participants & Poor muscle strength in 10 (3.33%) participants (130–total).[21] Similar findings found in a study by Stephen C. Kurachek et al in which reason of extubation failure was Upper airway obstruction in 63 (37.3%) participants, Pulmonary dysfunction in 46 (27.2%) participants, Respiratory muscle weakness in 22 (13.0%) participants, Hemodynamic instability in 16 (9.5%) & Neurologic factors in 16 (9.5%) participants.[17]

None of our patients had extubation failure due to upper airway obstruction as compare to other studies. This could be because of recent advances in ventilation policies such as use of micro-cuffed tubes, lesser duration of ventilation & use of steroids.

Liver enzymes were deranged in majority of study participants with SGOT affection being more than SGPT. 77 (93.9%) participants had SGOT value >35 U/L. 21 (25.6%) participants had SGPT value in between 40-80 U/L & 17 (20.7%) participants had >80 U/L.As per the available literature, Liver function tests (LFTs) provide critical information about the metabolic state helping to determine the readiness for extubation. Ensuring optimal liver function is therefore important to maintain the metabolic stability necessary for a successful extubation.[22]

9 (11%) participants had BUN value >18 mg/dl. 34 (41.46%) participants had creatinine value >1 mg/dl. As per the available literature, Renal function tests (RFTs) measure parameters such as blood urea nitrogen (BUN) and creatinine, which are essential in assessing the kidney's ability to filter waste and manage fluid and electrolyte balance. In the context of extubation, renal dysfunction can lead to fluid overload, electrolyte imbalances—particularly potassium disturbances-and acid-base disorders, all of which can compromise respiratory function. Uremia, resulting from poor renal function, can further impair cognitive and neurological function, leading to inadequate respiratory effort. Therefore, assessing and optimizing renal function are crucial to reduce the risk of extubation failure. [22]

Majority of participants did not have any complications while 5 (6.1%) participants had Ventilator Associated Pneumonia, 3 (3.7%) participants had Lung Collapse, 2 (2.4%) participants had Bed Sores and 2 (2.4%) participants had Pneumothorax.

In our study, less number of ventilator associated pneumonias and bed sores could be result of good nursing care & use of air beds.

The findings of the study were similar to study conducted by Punkaj Gupta et al in which 2 (14%) participants developed Pneumonia & 7 (50%) participants developed Atelectasis.[23] In another study conducted by Kwannapas Saengsin et al, 26 (74.29%) participants had Ventilator Associated Pneumonia.[24]

In our study 58 (70.7%) participants expired & 24 (29.3%) participants survived.

Findings of the study were not similar to the study by Aster Shawel Mekonnen et al in which 31 (15.65%) participants expired & 167 (84.35%) participants survived.[25]

In another study by Asaad G. Beshish et al, 23 (8.9%) participants expired & 234 (91.1%) participants survived.[18] The findings were not similar to the study by Khouloud A. Al-Sofyani et al, 5 (11.90%) participants expired & 37 (88.10%) participants survived.[26]

The outcome variation could be due to varied indication of ventilation, different clinic-demographical profile & different severity of the disease.

Majority of the study participants were diagnosed with septic shock out of which 8 (9.76%) participants diagnosed with LRTI with Septic Shock & 5 (6.10%) participants diagnosed with AGE with Septic Shock.

The findings of the study were in accordance with the study conducted by Punkaj Gupta et al in which 2 (12%) participants were diagnosed with septic shock.[19]

In another study conducted by Punkaj Gupta & Rachel McDonald et al, 6 (43%) participants were diagnosed with septic shock.[23]

There is statistically no significant correlation between Duration of Ventilation & outcome. The shorter durations of mechanical ventilation are generally associated with better outcomes; the correlation with patient outcomes is influenced by the underlying severity of illness, presence of co morbidities, and the development of complications. Prolonged ventilation is often a marker of more severe disease and is associated with higher risks of complications, weaning difficulties, and mortality, making it a critical factor in predicting patient outcomes.[27]

There is statistically no significant correlation between gender, reason of failure & outcome. Understanding the underlying reason for extubation failure is crucial for tailoring interventions and improving patient outcomes.[28] There is statistically no significant correlation between Hb, S Calcium, Vitamin D & outcome.

There is statistically no significant correlation between co morbidities & outcome.

There is statistically significant correlation between MODS & outcome and the **p value is 0.008**. MODS is a serious condition with an increased mortality, prolonged ICU and hospital stays, a higher risk of complications, and a complex treatment and recovery process with a guarded prognosis, requiring intensive management and careful monitoring. While treatment can improve outcomes, the impact of MODS on long-term health and quality of life underscores the importance of early recognition and comprehensive care in the PICU.[29]

Limitations

This research was limited by the small size and site (i.e. urban tertiary care hospital) of the study population, so the results obtained could not be generalized for the entire community and don't reflect healthcare facilities available to all health centers, particularly in the rural areas.

Conclusion

Infants have more incidence of extubation failure

compared to older children. The presence of Multiple Organ Dysfunction Syndrome (MODS) significantly affects patient outcomes. Checking extubation readiness and achieving it is a skilled task which needs good team work. With knowledge and anticipation of risk factors and use of improved strategies extubation outcomes can be improved.

Compliance with Ethical Standards
Funding None
Conflict of Interest None

References:

1. Venkataraman ST: Weaning and extubation in infants and children: religion, art or science. Pediatr Crit Care Med 2002; 3:203-205.
2. Schultz TR, Lin RJ, Watzman HM, et al: Weaning children from mechanical ventilation: A prospective randomized trial of protocol-directed versus physicians directed weaning. Respir Care 2001; 46:772-782.
3. Epstein SK. Decision to extubate. Intensive Care Med 2002; 28(5): 535-546.
4. Steven D Baisch, William B Wheeler, Stephen Kurachek et al,"Extubation Failure In pediatric Intensive care Incidence and Outcomes". Pediatr Crit Care Med 2005; May; 6(3):312-8.
5. Kwannapas Saengsin, Rekwan Sittiwangkul, Thirasak et al, "Predictive factors of extubation failure in pediatric cardiac intensive care unit; - A single center retrospective study from Thailand" Front.Pediatr.11:1156263 April 2023.
6. Pediatric Acute Lung Injury Consensus Conference Group. Pediatric acute respiratory distress syndrome: consensus recommendations from the Pediatric Acute Lung Injury Consensus Conference. Pediatr Crit Care Med. 2015; 16(5):428-39.
7. Hughes, Helen K., and Lauren K. Kahl. Blood Chemistries and Body fluids. In: Hughes, Helen K., and Lauren K. Kahl, (Ed) "The Harriet Lane Handbook: a Manual for Pediatric House Officers. 21st ed., Elsevier, 2018. p 708 to 720.
8. Gupta P, Chow V, Gossett JM, Yeh JC, Roth SJ. Incidence, predictors, and outcomes of extubation failure in children after orthotropic heart transplantation: a single-center experience. Pediatr Cardiol. 2015; 36(2):300-7.
9. Kurachek SC, Newth CJ, Quasney MW et al. Extubation failure in pediatric intensive care: a multiple-center study of risk factors and outcomes. Crit Care Med. 2003; 31(11):2657-64.
10. Manczur TI, Greenough A, Pryor D, Rafferty GF. Comparison of predictors of extubation from mechanical ventilation in children. Pediatr Crit Care Med. 2000; 1(1):28-32.
11. Epstein SK. Extubation failure: an outcome to be avoided. Crit Care. 2004; 8(5):310-2.
12. Edmunds S, Weiss I, Harrison R. Extubation failure in a large Pediatric ICU population. Chest. 2001; 119(3):897-900.
13. Khemani RG, Sekayan T, Hotz J et al. Risk factors for pediatric extubation failure: the importance of respiratory muscle strength. Crit Care Med. 2017; 45(8):798-805.
14. Baisch SD, Wheeler WB, Kurachek SC, Cornfield DN. Extubation failure in pediatric intensive care incidence and outcomes. Pediatr Crit Care Med. 2005; 6(3):312-8.
15. Kodicherla VV, Shaikh F, Duvvana PK et al. Clinico-etiological profile of children who had unplanned extubation and subsequent re-intubation in level-4 pediatric intensive care unit. Journal of Pediatric Critical Care. 2021 Mar 1; 8(2):67-73.
16. Hazarika A, Gupta A, Jain K, Kajal K. Incidence, Predictors, and Adverse Outcomes of Extubation Failure in Young Children with Isolated Traumatic Brain Injury: A Prospective Observational Study. Journal of Neuroanaesthesiology and Critical Care. 2021 Mar; 8(01):045-51.
17. Kurachek SC, Newth CJ, Quasney MW et al. Extubation failure in pediatric intensive care: a multiple-center study of risk factors and outcomes. Critical care medicine. 2003 Nov 1; 31(11):2657-64.
18. Beshish AG, Fundora MP, Aronoff E et al. Prevalence, Risk Factors, and Etiology of Extubation Failure in Pediatric Patients After Cardiac Surgery. Journal of Pediatric Intensive Care. 2022 Feb 14.
19. Gupta P, Chow V, Gossett JM, Yeh JC, Roth SJ. Incidence, predictors, and outcomes of extubation failure in children after orthotropic heart transplantation: a single-center experience. Pediatric cardiology. 2015 Feb; 36:300-7.
20. Kilba MF, Salie S, Morrow BM. Risk factors and outcomes of extubation failure in a South African tertiary paediatric intensive care unit. Southern African Journal of Critical Care. 2022; 38(1):26-32.
21. Baisch SD, Wheeler WB, Kurachek SC, Cornfield DN. Extubation failure in pediatric intensive care incidence and outcomes. Pediatric Critical Care Medicine. 2005 May 1; 6(3):312-8.
22. Kulkarni AP, Agarwal V. Extubation failure in intensive care unit: predictors and management. Indian J Crit Care Med. 2008 Jan; 12(1):1-9.
23. Gupta P, McDonald R, Gossett JM et al. A single-center experience of extubation failure in infants undergoing the Norwood operation. The Annals of thoracic surgery. 2012 Oct 1; 94(4):1262-8.
24. Saengsin K, Sittiwangkul R, Borisuthipandit T et al. Predictive factors of extubation failure in pediatric cardiac intensive care unit: a single-center retrospective study from Thailand. Frontiers in Pediatrics. 2023 Apr 17; 11:1156263.
25. Mekonnen AS, Kebede Z, Demissie DB. Incidence, Outcome and Determinants of Unplanned Extubation Among Pediatric Intensive Care Unit Addis Ababa, Ethiopia, 2023: Nested, Unmatched Case-Control Study Design. Pediatric Health, Medicine and Therapeutics. 2023 Dec 31:347-59.
26. Al-Sofyani KA. Predictors and outcomes of extubation failures in a pediatric intensive care unit: A retrospective study. Journal of Taibah University Medical Sciences. 2024 Jun 1; 19(3):516-23.
27. Heubel AD, Mendes RG, Barrile SR et al Extubation failure in pediatric intensive care unit: a retrospective cohort study. Fisioterapia e Pesquisa. 2020 Apr 6; 27:34-40.
28. Kanthimathinathan HK, Durward A, Nyman A, Murdoch IA, Tibby SM. Unplanned extubation in a paediatric intensive care unit: prospective cohort study. Intensive care medicine. 2015 Jul; 41:1299-306.
29. Weiss SL, Asaro LA, Flori HR et al. Multiple organ dysfunction in children mechanically ventilated for acute respiratory failure. Pediatric Critical Care Medicine. 2017 Apr 1; 18(4):319-29.