Curr Pediatr Res2025; 29 (03): 2391-2395 *ISSN 0971-9032*
www.currentpediatrics.com

Clinical Profile and Immediate Outcome of Ventilated Neonates Admitted in NICU of Tertiary Care Hospital in Central India.

Dipak Madavi, Nilima Kursunge, Lakshmikant A.Rohadkar*, Swati Kshirsagar, Sakshi Keshattiwar, Renoy Jose CL

Department of Pediatrics, Indira Gandhi Govt. Medical College, Nagpur 440018, Maharashtra, India

Received: *07 July, 2025, Manuscript No. AAJCP-25-167655;* ***Editor assigned:*** *09 July, 2025, Pre QC No. AAJCP-25-167655 (PQ);* ***Reviewed:*** *23 July, 2025, QC No. AAJCP-25-167655;* ***Revised:*** *30 July, 2025, Manuscript No. AAJCP-25-167655 (R);* ***Published:*** *08 August, 2025, DOI:10.35841/0971-9032.29.01.2391-2395*

Abstract

Background: A substantial proportion of neonates admitted to the Neonatal Intensive Care Unit (NICU) necessitate mechanical ventilation, and despite the implementation of advanced mechanical ventilation techniques, the mortality rate among critically ill neonates remains alarmingly high. Therefore, identifying adverse prognostic factors and devising appropriate interventions is imperative to enhance survival rates in this vulnerable population.

Objectives: To examine the clinical profile and immediate outcomes of neonates requiring mechanical ventilation.

Methods: This prospective observational study was conducted in the Neonatal Intensive Care Unit (NICU) of Indira Gandhi Government Medical College and Mayo Hospital, Nagpur, Maharashtra, Central India, from May 2022 to April 2024. The study population comprised ventilated neonates admitted to the NICU, who were subsequently enrolled. Risk factors were meticulously documented. All data were recorded in an Excel spreadsheet, and results were presented in terms of frequency and percentage. The study received approval from the institutional ethical committee.

Results: A total of 85 mechanically ventilated neonates, who met both inclusion and exclusion criteria, were enrolled following the acquisition of written informed consent from the guardians. Among the 85 neonates, 45 (53%) were male and 40 (47%) were female. Regarding the mode of delivery, 36 (42.3%) were delivered vaginally, while 49 (57.7%) underwent caesarean section. The highest incidence of neonates requiring mechanical ventilation, 27 (31.7%), fell within the gestational age range of 28 to 32 weeks. Notably, the majority of neonates, 50 (58.8%), who required mechanical ventilation, had a birth weight between 1500 and 2499 grams. Of the 85 mechanically ventilated neonates, respiratory distress was the predominant clinical presentation, observed in 46 (54.1%), followed by jaundice in 11 (13%), poor feeding in 9 (10.6%), lethargy in 7 (8.2%), and convulsions in 7 (8.2%). Additionally, abdominal distension, vomiting, and bleeding were documented in 1 (1.2%), 3 (3.5%), and 1 (1.2%) neonates, respectively. Perinatal asphyxia emerged as the most prevalent indication for mechanical ventilation in 28 (33%) cases, succeeded by neonatal sepsis in 27 (31.8%), respiratory distress syndrome (RDS) in 14 (16.4%), and meconium aspiration syndrome (MAS) in 10 (11.8%). Furthermore, apnoea of prematurity and persistent pulmonary hypertension of the newborn (PPHN) were noted in 4 (4.7%) and 2 (2.3%) neonates, respectively. Among the 85 mechanically ventilated neonates, 25 (29.4%) developed complications attributable to mechanical ventilation, with the most common being septicemia in 11 (12.9%), pneumothorax in 5 (5.9%), pulmonary hemorrhage in 5 (5.9%), and ventilator-associated pneumonia (VAP) in 4 (4.7%). Out of the 85 neonates, 52 (61.2%) survived and were subsequently discharged, while 33 succumbed, resulting in a mortality rate of 38.8%.

Conclusion: In the present study, we observed that respiratory distress constituted the most prevalent clinical presentation, underscoring the critical necessity for respiratory support in these neonates. Perinatal asphyxia and neonatal sepsis were identified as the primary indications for mechanical ventilation, highlighting their substantial contribution to the demand for respiratory intervention among neonates. Septicaemia emerged as the most frequent complication during ventilation, exerting diverse effects on patient outcomes. The overall discharge rate surpassed the mortality rate, indicating a favourable prognosis. Survival rates appeared to improve with shorter durations of ventilation and more effective management of complications.

Keywords: Mechanical ventilation; Gestational age; Birth weight; Perinatal asphyxia; Neonatal sepsis; Mortality

Accepted on 09th July; 2025

Introduction

Neonatal mortality, defined as the death of a newborn within the first 28 days of life, is a critical public health concern that has significant implications for the well-being of societies worldwide. In 2022, the global neonatal mortality rate was 17.3 deaths per 1,000 live births [1]. India's neonatal mortality rate of 25 per 1,000 live births in 2021[2] is significantly higher than the global average. Many studies reveal that nearly half (32-52%) of this is due to respiratory distress in the neonatal period. Respiratory distress is one of the commonest problems of neonates occurring throughout the world (3-7% of all live births) [3-6]. Neonatal assisted ventilation has revolutionized the outcome of sick newborns in ICUs of the developed world in the last two decades [7,8].The widespread introduction of assisted ventilation into neonatal intensive care units during the 1960s and 1970s substantially improved the outcome of sick infants, particularly those with respiratory disorders [9].It is possible to increase neonatal survival and improve the quality of life only through prompt and adequate management of newborns, which cannot be thought of without respiratory intensive care and assisted ventilation. Babies with perinatal hypoxia and birth asphyxia, as well as critically sick babies, who develop life-threatening apnoea or cardiovascular collapse, need mechanical ventilation [10].

A considerable proportion of neonates admitted to the NICU require mechanical ventilation, and despite the application of advanced mechanical ventilation techniques, the mortality rate remains alarmingly high among these vulnerable neonates. Therefore, to improve survival rates in mechanically ventilated neonates, it is imperative to identify poor prognostic factors and address them effectively. Given that the outcomes for mechanically ventilated neonates dependent on a multitude of factors such as the primary disease condition, gestational age, birth weight, and accompanying comorbidities, we have undertaken a study to examine the clinical profiles of these neonates and their immediate outcomes.

Materials & Methods

Study design and setting

A prospective observational health facility-based study was conducted in the Neonatal Intensive Care Unit (NICU) of Indira Gandhi Government Medical College and Mayo Hospital, Nagpur, Maharashtra, central India, from May 2022 to April 2024.

Study participants

The study population comprised ventilated neonates admitted to the NICU. A sample size of 85 subjects was determined using the survival rate of ventilated neonates (p)=78%, as reported in [11], with an absolute error (l) of 10% and a level of significance (α) of 5%.

Data collection

This prospective observational study was conducted within the NICU of a tertiary healthcare facility in Central India. For data collection, neonates meeting the inclusion criteria were enrolled in the study following the acquisition of written informed consent from their guardians. Confidentiality of the data was rigorously maintained. A predetermined Case Report Form was utilized to document the information. Cases were enrolled within 24 hours of the initiation of mechanical ventilation. Basic information regarding each neonate was gathered. The study encompassed neonates admitted to the NICU who required mechanical ventilation, including those delivered in our facility (inborn) as well as those referred from other hospitals and delivery centres, and neonates delivered at home (out born). A total of 85 neonates were included in the present study. Neonates whose parents declined to provide consent were excluded. Comprehensive natal histories of the enrolled neonates were obtained, encompassing the mode of delivery, birth weight, whether the infant cried immediately post-delivery, and if not, the details of resuscitation efforts and the Apgar score were documented. Gestational age was evaluated using the New Ballard Score. Presenting complaints of the neonates were meticulously noted. Neonates were managed according to standard NICU protocols. Clinical diagnoses of sepsis, Hypoxic-Ischemic Encephalopathy (HIE), Respiratory Distress Syndrome (RDS), Meconium Aspiration Syndrome (MAS), and Persistent Pulmonary Hypertension of the Newborn (PPHN) were established, and the treatment administered upon admission was recorded. Laboratory examinations were conducted to arrive at a definitive diagnosis.

Statistical analysis

All data were recorded in an excel spreadsheet, and results were presented in terms of frequency and percentage.

Ethical consideration

The study received approval from the institutional ethical committee. Information obtained during the study was confidential. Patient who met both inclusion and exclusion criteria, were enrolled following the acquisition of written informed consent from the guardians or parents in their local language.

Results

This prospective observational study was conducted within the NICU of a tertiary healthcare facility in Central India over a period of two years. During the study period total of 85 mechanically ventilated neonates, who met both inclusion and exclusion criteria, were enrolled. Table 1 shows demographic characteristics of study population. Out of the 85 neonates enrolled 45 (53%) were male and 40 (47%) were female. As

per mode of delivery 36(42.3%) were delivered by vaginal and 49(57.7%) were delivered by LSCS. Maximum number of neonates required mechanical ventilation 27(31.8%) were between gestational age 28 to 32 weeks, 8(9.4%) neonates were less than 28 weeks, 22(25.9%) neonates were between 32 and 34 weeks, 20(23.5%) neonates were between 34 and 37 weeks and 8(9.4%) neonates were above 37 weeks. Highest number of neonates 50(58.8%) required mechanical ventilation was having birth weight between 1500-2499 grams, 13(15.3%) neonates were less than 1000 grams, 10(11.8%) neonates were between 1000-1499 grams, and 12(14.1%) neonates were more than 2500 grams. Duration of mechanical ventilation required was more than 5 days in 41(48.2%) neonates, 36(42.4%) required ventilation for 2-5 days, less than 24 hours in 8(9.4%).

Neonatal demographic characteristics	Frequency	Percentage (%)
Gender		
Male	45	53
Female	40	47
Mode of delivery		
NVD	36	42.3
LSCS	49	57.7
Gestational age		
<28 weeks	8	9.4
28-32 weeks	27	31.8
32-34 weeks	22	25.9
34-37 weeks	20	23.5
≥ 37 weeks	8	9.4
Birth weight		
<1000 grams	13	15.3
1000 -1499 grams	10	11.8
1500-2499 grams	50	58.8
>2500 grams	12	14.1
Duration of mechanical ventilation		
<24 hours	8	9.4
1-5 days	36	42.4
>5 days	41	48.2

Table 1: Neonatal demographic characteristics, (n=85).

Table 2 shows distribution of neonates based on clinical presentation of neonates based on clinical presentation. Of the 85 mechanically ventilated neonates, respiratory distress was the predominant clinical presentation, observed in 46 (54.1%), followed by jaundice in 11 (13%), poor feeding in 9 (10.6%), lethargy in 7 (8.2%), and convulsions in 7 (8.2%). Additionally, abdominal distension, vomiting, and bleeding were documented in 1 (1.2%), 3 (3.5%), and 1 (1.2%) neonates, respectively.

Clinical presentation	Frequency	Percentage (%)
Respiratory distress	46	54.1
Lethargy	7	8.2
Poor feeding	9	10.6
Jaundice	11	13
Convulsions	7	8.2
Abdominal distension	1	1.2
Vomiting	3	3.5
Vomiting	3	3.5

Table 2: Distribution of neonates based on clinical presentation, (n=85).

Table3 shows the distribution of neonates based on clinical Indications of mechanical ventilation. Perinatal asphyxia emerged as the most prevalent indication for mechanical ventilation in 28 (33%) cases, succeeded by neonatal sepsis in 27 (31.8%), Respiratory Distress Syndrome (RDS) in 14 (16.4%), and Meconium Aspiration Syndrome (MAS) in 10 (11.8%). Furthermore, apnoea of prematurity and Persistent Pulmonary Hypertension of The Newborn (PPHN) were noted in 4 (4.7%) and 2 (2.3%) neonates, respectively.

Clinical indications	Frequency	Percentage (%)
Perinatal asphyxia	28	33
Neonatal sepsis	27	31.8
RDS	14	16.4
MAS	10	11.8
Apnoea of prematurity	4	4.7
PPHN	2	2.3

Table 3: Clinical indications of mechanical ventilation, (n=85).

Table 4 shows complications of mechanical ventilation. Among the 85 mechanically ventilated neonates, 25 (29.4%) developed complications attributable to mechanical ventilation, with the most common being septicemia in 11 (12.9%), pneumothorax in 5 (5.9%), pulmonary hemorrhage in 5 (5.9%), and Ventilator-Associated Pneumonia (VAP) in 4 (4.7%).

Complication	Frequency	Percentage (%)
Septicaemia	11	12.90%
Pneumothorax	5	5.90%
Pulmonary haemorrhage	5	5.90%
VAP	4	4.70%

Table 4: Complications of mechanical ventilation, (n=85).

Table 5 shows the immediate outcome of mechanically ventilated neonates. Out of the 85 neonates, 52 (61.2%) survived and were subsequently discharged, while 33 succumbed, resulting in a mortality rate of 38.8%.

Immediate outcome	Frequency	Percentage (%)
Discharge	52	61.2
Death	33	38.8

Table 5: Immediate outcome of mechanically ventilated neonates, (n=85).

Discussion

This prospective observational study was conducted in the Neonatal Intensive Care Unit (NICU) of a tertiary care hospital in Central India over a span of two years, from May 2022 to April 2024, with the objective of examining the clinical profile and immediate outcomes of neonates requiring mechanical ventilation. In the present study, out of 85 mechanically ventilated neonates, 45 (53%) were male and 40 (47%) were female. The proportion of males in this study (53%) contrasts with findings reported by Dutt RD et al., [12] 64.5%, Anjana Acharya et al., [13] 68%, and Hima Bindu Singh et al., [14] 60%. Conversely, the percentage of females in the current study was 47%, compared to Dutt RD, et al. 35.4%, Anjana Acharya, et al., 32%, Shwetal Bhatt, et al., 42.3%, and Hima Bindu Singh, et al., 40%.

In this study, among the 85 mechanically ventilated neonates, 36 (42.3%) were delivered *via* vaginal delivery, while 49 (57.7%) were delivered through Lower Segment Cesarean Section (LSCS). Previous research by Shwetal Bhatt, et al., [15] reported a higher incidence of vaginal deliveries at 76.5%, whereas Shahjadi Nasreen Sultana, et al., [16] documented a

significantly lower rate of 28.3%. The present study indicates a moderate LSCS rate of 57.6%, which is higher than the 23.5% reported by Shwetal Bhatt, et al. but lower than the 71.7% observed by Shahjadi Nasreen Sultana, et al.

The current study revealed that the majority of neonates requiring mechanical ventilation 27 (31.8%) were between 28 to 32 weeks of gestational age. Additionally, 8 (9.4%) neonates were under 28 weeks, 22 (25.9%) were between 32 and 34 weeks, 20 (23.5%) were between 34 and 37 weeks, and 8 (9.4%) were over 37 weeks. The percentage of neonates with gestational ages between 28 and 32 weeks (31.8%) was notably higher than findings reported by Shrestha et al., [17] and closely aligned with those of Shahjadi Nasreen Sultana, et al.

The present study documented that 13 (15.3%) neonates were born with a birth weight of less than 1000 grams, 10 (11.8%) weighed between 1000-1499 grams, 50 (58.8%) were within the range of 1500-2499 grams, and 12 (14.1%) exceeded 2500 grams. In comparison to the findings of Shwetal Bhatt, et al. 4.1% and Hima Bindu Singh, et al., 10%, the present study indicates a higher prevalence of 15.3% for neonates born with a weight under 1000 grams. Furthermore, the percentage of neonates weighing between 1000-1499 grams was the lowest in this study 11.7% compared to Shwetal Bhatt, et al., 30.7%, Anjana Acharya, et al., 21.3%, and Hima Bindu Singh, et al., 26.9%. Notably, the present study recorded the highest percentage of neonates weighing between 1500-2499 grams at 58.8%, surpassing other studies by Shwetal Bhatt, et al. 46.4%and Hima Bindu Singh, et al., 34.6 , as well as Anjana Acharya et, al., 37.3%. The percentage of neonates exceeding 2500 grams in the current study was 23.4%, which is comparable to findings reported by Hima Bindu Singh, et al., 28.4%.

In this study, 28 (33%) neonates required mechanical ventilation due to perinatal asphyxia, 27 (31.8%) due to neonatal sepsis, 14 (16.4%) for respiratory distress syndrome (RDS), 10 (11.8%) for meconium aspiration syndrome (MAS), while 4 (4.7%) and 2 (2.3%) neonates required ventilation for apnea of prematurity and Persistent Pulmonary Hypertension of Tthe Newborn (PPHN), respectively. A study conducted by Prajakta Dekate, et al., [18] also reported similar findings regarding the indications for mechanical ventilation in neonates. The present study found that 27 (31.8%) neonates required mechanical ventilation due to neonatal sepsis, while Shwetal Bhatt, et al., documented an incidence of 11.2%. The incidence of RDS in this study was 16.4%, which is comparable to the findings of Prajakta Dekate, et al., 19.4% and Dutt RD et al., 18.9%. Mechanical ventilation was required for MAS in 11.8% of neonates, aligning closely with Prajakta Dekate, et al., 12.1%. The incidence of apnea of prematurity in this study was 4.7%, consistent with findings from Prajakta Dekate, et al. The rate of PPHN requiring mechanical ventilation was also reported at 4.7% in this study, with Anjana Acharya, et al., documenting a rate of 6.7% and Shwetal Bhatt et al., reporting 1.8%.

This study indicated that 8 (9.4%) of neonates were mechanically ventilated for less than 24 hours, 36 (42.4%) for 2-5 days, and 41 (48.2%) for more than 5 days.

Among the mechanically ventilated neonates, 11 (12.9%) developed septicemia, 5 (5.9%) experienced pneumothorax, 5 (5.9%) suffered from pulmonary hemorrhage, and 4 (4.7%) developed Ventilator-Associated Pneumonia (VAP).

The present study reported a 12.9% incidence of septicemia, which contrasts with research by Anjana Acharya, et al., that indicated an incidence of 32.4%, and by Md Abdul Mannan, et al., [19] who reported a 10% incidence.

In this study, 5.9% of mechanically ventilated neonates developed pneumothorax, whereas Md Abdul Mannan, et al., documented a rate of 12%.

Similarly, 5.9% of neonates experienced pulmonary hemorrhage, which aligns with findings from Shwetal Bhatt et, al., 4.11% and Md Abdul Mannan, et al., 4%. The incidence of VAP in this study was 4.7%, in contrast to Md Abdul Mannan et al., who reported 14%, and Shwetal Bhatt, et al., who documented 5.3%.

Out of the 85 (100%) mechanically ventilated neonates in the present study, 52 (61.2%) survived and were subsequently discharged, while the observed mortality rate was 33 (38.8%). Comparatively, mortality rates reported in other studies include 22% by Md Ajaz, et al., [20], 70.7% by Hima Bindu Singh, et al., and 50.7% by Anjana Acharya, et al.

The survival rate of mechanically ventilated neonates in the present study was 61.2%, which is higher than the rates reported by Dutt RD, et al., 48%, Basant K Shah Singh, et al., [21] 50.8%, Prajakta Dekate, et al., 45.6%, and Shahjadi Nasreen Sultana, et al., 35.8%.

Limitations

Since the study was a single centered observational study, the findings cannot be generalised to other study settings.

Conclusions

In the present study, we observed that respiratory distress constituted the most prevalent clinical presentation, underscoring the critical necessity for respiratory support in these neonates. Perinatal asphyxia and neonatal sepsis were identified as the primary indications for mechanical ventilation, highlighting their substantial contribution to the demand for respiratory intervention among neonates. Septicemia emerged as the most frequent complication during ventilation, exerting diverse effects on patient outcomes. The overall discharge rate surpassed the mortality rate, indicating a favorable prognosis. Survival rates appeared to improve with shorter durations of ventilation and more effective management of complications.

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Corresponding Author:

Lakshmikant A.Rohadkar

Assistant Professor, Department of Pediatrics, Indira Gandhi Govt. Medical College

Nagpur 440018, Maharashtra, India

Email: pmbbs13@gmail.com