Original Article

IAHS Medical Journal
Volume 04 Issue 01 June 2021; 27-32

Immediate Outcome of Mechanically Ventilated Neonate : One Year Experience in Neonatal Intensive Care Unit of Combined Military Hospital Dhaka

Bijoy Kumar Das[1*] Nurun Nahar Fatema Begum[2] Sabina Yasmeen[3] Biplob Kumar Raha[4]

ABSTRACT

Background: *A large number of neonates in intensive care unit require mechanical ventilation due to various disease conditions. There has been a dramatic fall in neonatal mortality in developed countries with the advent of mechanical ventilation. This study was carried out to see the immediate outcome of neonates who required mechanical ventilation.*

Materials and methods: *This prospective observational study was carried out in Neonatal Intensive Care Unit, CMH Dhaka from January 2016 to December 2016. Neonates who required mechanical ventilation during the study period were enrolled in this study. During the time of mechanical ventilation neonates were followed up for any complication till discharge or death.*

Results: *Total 30 neonates were enrolled in the study. Among them 22(73.3%) of the neonates were preterm and 8(26.7%) were term, 25(83.3%) having birth weight <2500 gm. Respiratory Distress Syndrome was the most common reason for mechanical ventilation accounting for 11(36.7%),other indications were Perinatal Asphyxia 7(23.3%), Septicemia 6(20.0%), Congenital Pneumonia 5(16.7%) and Meconium Aspiration Syndrome 1(3.3%). Common complications during the period of ventilation were Septicemia (40.0%), Acute Renal Failure (16.7%), Pneumonia (16.7%), Pulmonary Hemorrhage (10.0%), Intraventricular Hemorrhage (6.7%), Pneumothorax(10.0%) and Heart Failure (6.7%). 17(56.7%) neonates survived and 13(43.3%) were died. Most of the neonate died of Perinatal Asphyxia 4(57.1%), Septicemia 3(50.0%), RDS 5(45.5%) and Congenital Pneumonia 1(20.0%).*

Conclusion: *The survival rate of ventilated neonates was 56.7%. The higher gestational age and birth weight was significantly associated with better outcome. Septicemia and Pneumonia (PNA) was the leading cause of death in this study. Effective measures for prevention and management of sepsis could improve the outcome of neonates in NICU.*

Key wards: Mechanical ventilation; Neonate; Neonatal sepsis; Perinatal asphyxia.

Introduction

Among the global birth scenario, nearly 3.5 million neonates are born each year in Bangladesh accounting for 2.7%[1]. Out of this number of neonates, 74000 die before initial four weeks of their life[2]. The number of neonatal mortality in developed region 3 per 1,000 live births, Pakistan 42 per 1,000 live births, India 29 per 1,000 live births[3]. Bangladesh is a resource limited developing country in South-East Asia with neonatal mortality rate 24.40 per 1000 live births[3].

The risk of death in the 1st month of life 23 per 1000 live births is nearly two and a half times greater than in the subsequent 11 months[4]. Deaths in the neonatal period account for 62 percent of all under 5 deaths[4]. Improving intensive care facilities for the neonates in the country could be one of the effective interventions to achieve the global target of reducing under five mortality by two thirds.

Mechanical Ventilation (MV) has become an indispensable part of neonatal intensive care[5]. The introduction of mechanical ventilation was one of the major new inventions in neonatology which provided life-saving support for neonates with respiratory failure[5]. A large number of neonates in neonatal intensive care unit require mechanical ventilation[6]. Babies with perinatal hypoxia & birth asphyxia, preterm, low birth weight baby, Meconium Aspiration Syndrome (MAS), RDS as well as critically sick babies who developed life threatening apnea, progressive

1. Major & Classified Child Specialist
Combined Military Hospital (CMH) Jashore.
2. Brig Gen & Professor of Paediatrics
Armed Forces Medical College, Dhaka,
3. Colonel & Classified Child Specialist & Neonatologist
Combined Military Hospital (CMH) Dhaka.
4. Lt Col & Classified Child Specialist
Combined Military Hospital (CMH) Sylhet.

*Correspondence : **Major (Dr.) Bijoy Kumar Das**
Cell : +88 01712 12 28 83
Email : bijoydas21@yahoo.com

Date of Submission : 22nd May 2021
Date of Acceptance : 12th June 2021

IAHS Medical Journal
Volume 04 Issue 01 June 2021; 27-32

respiratory distress with impending respiratory failure or cardiovascular collapse need mechanical ventilation[7]. So, mechanical ventilation has become a must to enhance newborn survival in those situations[7]. The survival of sick neonates have improved significantly with the widespread use of mechanical ventilation in NICUs[8].

Over the past three decades neonatal mortality has fallen steadily. Success of intensive care is usually presented as mortality rate adjusted for severity of illness[6]. Mechanical ventilation has definitely improved the survival of sick neonates but as a complex and invasive technology, mechanical ventilation can result in numerous complications such as pneumothorax, broncopulmonary dysplasia, pneumonia, nosocomial infection and Intraventricular Hemorrhage (IVH)[9]. These mechanically ventilated neonates have a high fatality[10].

MV (Mechanical Ventilation) was introduced in the West in 1960s to support the infants with respiratory failure[11]. This innovative technology have reached to significant level in affluent nation, but due to its high cost, expert skill requirements has limited its use in developing countries[12].

Bangladesh is a developing country. The experience of neonatal ventilation in Bangladesh is relatively recent and it was 1st adopted in Dhaka Shishu Hospital in 1992. In CMH Dhaka neonatal ventilation has been carried out since 1998 in NICU. This study was carried out to see the immediate outcome of neonates who required mechanical ventilation and complications during mechanical ventilation and to relate the immediate outcome with diseases for which ventilation was initiated.

Materials and methods

This hospital based cross sectional prospective study was done in Neonatal Intensive Care Unit (NICU), Combined Military Hospital Dhaka from January to December 2016. All neonates requiring mechanical ventilation during this period were prospectively included in this study. Neonate with congenital anomalies which was incompatible to life required mechanical ventilation were excluded from the study. Machine used for mechanical ventilation is either Hamilton or Dragger ventilator (Time cycled, pressure limited and continuous flow ventilator). The indications for mechanical ventilation were i) PaO_2<50 mm of Hg or SaO_2<85% with FiO_2 requirement more than 10 liter/min ii) $PaCO_2$>55 mm of Hg with pH <7.2 or $PaCO_2$>60 mm of Hg iii) Intractable apneic spell. Temperature, pulse, respiration and oxygen saturation were continuously monitored in all neonates. Oxygen saturation was maintained between 92 and 95%. Oxygen saturation was monitored by noninvasive pulse oximetry. Apnea monitor was used to monitor respiratory rate and heart rate. Arterial blood gas was monitored by OPTI-CCA TS2 gas analyzer. Parameters of ventilator were recorded e.g. ventilation rates, peak inspiratory pressure, inspiratory time, peak end expiratory pressure, FiO_2, gas flow. The ventilator settings were adjusted according to the underlying diseases and acid-base measurement. Weaning was attempted when the babies showed clinical improvement and blood gas report showed PO2 60-90 mmHg, PCO_2 41-50 mmHg, pH >7.30 and when the baby had been stable[13]. All data was recorded in a specially designed data collection sheet. After completion of data collection, the data was analyzed by using SPSS version 21.

Results

The study included 30 ventilated neonates. There was male predominance, ratio was 1.7:1. (Table 1) Two third neonates (60%) was inborn. 22(73.3%) were preterm (<37 weeks) and 8(26.7%) were term (>37 weeks) (Table I). Mean gestational age was 32.59±3.54 weeks (Table II). The mean birth weight of the study neonates was 1800±741 gm. of which 5(16.6%) were normal (> 2500 gm.) birth weight, 10(33.3%) were low birth weight (<2500 gm.), 12(40%) were very low birth weight (<1500 gm.) and 3(10%) neonates were extreme low birth weight (<1000 gm.) babies (Table I).

Mean age at onset of mechanical ventilation was 2.9 ± 5.23 days. Mean duration of mechanical ventilation was 4.1 ± 2.61 days and mean duration of total hospitalization was 13.1 ± 5.77 days (Table II).

Respiratory Distress Syndrome (RDS) was the commonest indication 11(36.7%) of mechanical ventilation. The other indications were Perinatal Asphyxia 7(23.3%), Septicemia 6(20.0%) and Congenital Pneumonia 5(16.7%) MAS 1(3.3%) (Table III).

Most of the neonate developed complications while in the mechanical ventilator. Among them most common was Septicemia (40.0%). Other complications were Acute Renal Failure (16.7%) and Pneumonia (16.7%) Pneumothorax (10.0%) Pulmonary Hemorrhage (10%), Intra Ventricular hemorrhage 6.7%, Heart Failure 6.7%. One patient may had more than one complication (Table IV).

Among 30 ventilated neonates, 13(43.3%) died and 17(56.7%) neonates survived (Figure-1).

Among them 05(38.5%) died of RDS, 4(30.8%) of PNA, 3(23.1%) of Septicemia and 1(7.7%) died of congenital pneumonia.

Preterm patient died more 11(50.0%) than term 02(25.0%). 12(48.0%) LBW baby died than normal birth weight 1(20.0%). Out born (58.33) baby died more than inborn (33.33%) (Table-V). Outcome in relation to mechanical ventilation was good in MAS (100%), Congenital pneumonia (80%), RDS (54.55%) than septicemia (50%) and PNA (42.9%) (Table-VI).

IAHS Medical Journal
Volume 04 Issue 01 June 2021; 27-32

Table I Demographic characteristics of ventilated neonate

Demographic characteristics	n	%
Sex		
Male	19	73.3
Female	11	26.7
Gestational age (weeks)		
≤37	22	11.3
≤37	08	20.8
Birth weight (g)		
<1000	03	10
1000-<1500	12	40
1500-<2500	10	33.3
≥2500	05	16.7
Birth place		
Inborn	18	60
Out born	12	40

Table II Profile of ventilated neonate with variable

	Mean±SD	Range
Age (Days)	2.3± 3.5	1-28
Gestational age (Weeks)	32.59±3.54	28-42
Birth weight (gm)	1800 ± 741	900-3850
Initial arterial PH	7.22± 0.12	6.91-7.35
Age at initiation of ventilation(Days)	2.9 ± 5.23	1-28
Duration of ventilation (Days)	4.1± 2.61	3-15
Duration of total hospitalization (Days)	13.1±5.77	8-28

Table III Indication of MV

Indication of MV	No	%
RDS	11	36.36
PNA	07	23.33
Septicemia	06	20.0
Congenital Pneumonia	05	17.0
MAS	01	3.33

Table IV Distribution of neonate having MV by types of complication

Types of Complication of MV	n	%
Sepsis	12	40.0
Pneumothorax	03	10.0
Acute renal failure	05	16.7
Pneumonia	05	16.7
Pulmonary hemorrhage	03	10.7
Intraventricular hemorrhage	02	6.7
Heart Failure	02	6.7

One patient may have more than one complication.

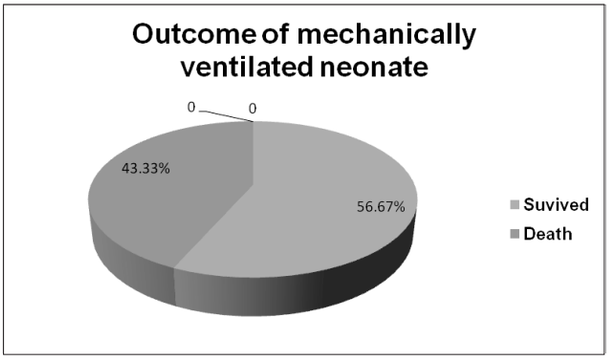

Figure 2 Outcome of mechanically ventilated neonates

Table V Outcome of mechanically ventilated neonate by different attributes

Different attributes	Death n(%)	Survivor n (%)	p value
Gestation			
Preterm	11(50.0)	11 (50.0)	0.2
Term	02 (25.0)	06 (75.0)	
Sex			
Male	08 (42.1)	11 (57.9)	0.8
Female	05 (45.5)	06 (54.5)	
Birth weight			
>2500 gm	01 (20.0)	04 (80.0)	0.2
<2500 gm	12 (48.0)	13 (62.0)	
Place of delivery			
Out born	07 (58.3)	5 (41.7)	0.17
Inborn	06 (33.3)	12 (66.7)	

Table VI Distribution of outcome of mechanically ventilated neonates by indications of MV

Indication of MV	Death n (%)	Survivor n (%)
RDS	05 (45.5)	06 (54.5)
PNA	04 (57.1)	03 (42.9)
Septicemia	03 (50.0)	03 (50.0)
Congenital pneumonia	01(20.0)	04 (80.0)
MAS	00 (00.0)	01 (100)

Discussion

30 mechanically ventilated neonates were included in this study. Seventy three percent 22(73.3%) of the neonates were preterm and 8(26.7%) were term. The mean gestational age was 32.59 ± 3.54 weeks. Tortman found that mean gestational age of baby requiring mechanical ventilation were 35.2 ± 2.6 weeks[14]. Preterm, Low birth weight neonate were more ventilated as they were more prone to develop RDS and Septicemia[14].

Male infants were predominant and ratio was 1.7:1. Hossain et al showed the male predominance in his studies and ratio was 1.42:1[15]. The mean birth weight of

IAHS Medical Journal
Volume 04 Issue 01 June 2021; 27-32

the ventilated neonates in this study were 1800 ± 741 gram of which 5(16.7%) had normal birth weight (>2500 gm), 10(33.3%) had LBW (<2500 gm), 12(40.0%) had VLBW (<1500 gm.) and 3(10.0%) neonates had ELBW (<1000 gm.). Among the babies 60.0% were inborn and 40.0% were out born. Kishan et al found that the majority of the baby were out born (78.0%) and 22.0% were inborn[16]. Results didn't match with this study as in Army most of the babies were delivered in hospital.

RDS was the common indication for MV in present study comprising about 11(36.7%) of the cases. The other indications for MV were Perinatal Asphyxia 7(23.3%), Septicemia 6(20.0%) Congenital Pneumonia 5(16.7%) and Meconium Aspiration Syndrome 1(3.3%). Tortman showed RDS was 63.0% cases which is also similar to Nangia S et al and Mathur NC et al[14,10,17]. Nangia S et al showed Perinatal Asphyxia as the second most cause for mechanical ventilation (28.3%)[10,17]. Hossain MM showed indications for MV were Perinatal Asphyxia, Septicemia, RDS, Congenital Pneumonia, Apnea of prematurity. Whatever, almost all study showed these are the common indications for mechanical ventilation[18].

In this study one patient may had more than one complication. The most common complication was Septicemia (40.0%). These are more in out born and low birth weight babies who are more prone to sepsis. Nangia S et al. also found commonest complication as Sepsis (26.0%)[10]. Pulmonary air leak was the common complication in western literature and in West Indies[19,17]. In the present study 3(10.0%) patient developed air leak (Pneumothorax). This may be due to use of lower peak airway pressure in our settings. High CPAP, peak and mean airway pressure and prolong inspiratory time were implicated as important factors causing air leak[20]. Other complications were Acute Renal Failure (16.7%) Pneumonia (16.7%) Pulmonary Hemorrhage (10.0%) Intraventricular Hemorrhage (6.7%) and Heart Failure (6.7%). All these complications were commonly occurred in other study[10,17,19].

Among 30 ventilated neonates 13(43.3%) were died. Hossain MM et al showed death rate of ventilated neonates as 70.6%[15]. Death rate of this study differed from current study but a study in West Indies by H Tortman showed 59.0% survival and 41.0% death which is similar to this study[14]. Nangia S et al showed 46.5% survival in her study[10]. Hossain MM showed the overall survival rate was 24.5%[18]. But survival rate was higher in developed countries (91.0%) by Singh M et al.[19] This compares favorably with figures quoted for other developing countries (46-54%)[6,21,22]. Differences in outcome of ventilated neonates between developed and developing countries may be related to the ready availability of surfactant and parenteral nutrition in developed countries as compared to developing countries.

Among the death cases preterm neonates died more (50.0%) than term (25.0%) p value 0.2, not significant. out born died more (58.3%) than inborn (33.3%), p value 0.17, not significant, Low birth weight infants died more (48.0%) than that of normal birth weight (20.0%) p value 0.2, not significant. Nangia S et al showed in their study that survival rates increased with increasing birth weight changing from 25.0% for <1000 gm. to 53.0% for >2500 grams[10].

In this study total number of death were 13. Among them more death occurred due to RDS 5(45.5%). No neonate died due to MAS. Total 11 neonates were put on mechanical ventilation due to RDS. Among them 5(45.5%) patients died and 6(54.5%) survived. That means neonates with RDS requires mechanical ventilation more and prognosis is good. Tortman reported that babies who required mechanical ventilation due to RDS had 42.0% death which is similar with this study, but he revised that the non-survivors in his study were noted to be the smaller, less mature babies[14]. This association of low birth weight and immaturity with poor survival has been documented in other studies[17,21]. This is not unexpected, as RDS is seen primarily in the preterm neonate and its severity increases with decreasing maturity; decreased maturity is associated with increased mortality.

Conditions associated with increased mortality in this study were Perinatal asphyxia and Septicemia. In Perinatal Asphyxia 4(57.1%) neonates died and 3(42.9%) survived which was almost similar to the study done in India (51.0%)[17]. Hypoxic Ischemic Encephalopathy results from anoxic injury to the brain and the ones requiring ventilation is extremely poor[18].

In Septicemia 3(50.0%) patients died and 3(50.0%) were survived. That means mortality was high in Septicemic patient requiring mechanical ventilation[23]. This is expected as neonate with septicemia who required ventilation ware severely ill. Maiya et al found that all infants with sepsis requiring MV survived[24]. Lindroth's study showed survival increase from 45 to 69% over the study period due to earlier diagnosis and treatment[25]. Pneumonia had a better outcome (80.0%) in relation to Septicemia and this finding is in conformity with the Indian study[19]. Infection of all kinds which included Septicemia and Pneumonia had poor outcome with MV. Infection itself does not warrant MV but the acidosis due to infection leads to wide spread multiple organ damage, respiratory failure and apneic attack which necessitates MV. Overwhelming infection, prematurity and delayed institution of management may be the cause of high mortality in babies with infection[24].

IAHS Medical Journal
Volume 04 Issue 01 June 2021; 27-32

One neonate was put on mechanical ventilation due to MAS and survived. Babies with MAS requiring MV had the best outcome, 9/11 (82.0%) survived in Totman H study[14].

In this study mean duration of total hospitalization was 13.1 ± 5.77 days. Iqbal Q showed in his studies that mean duration of hospitalization were 10.3 ± 10.1 days[26]. Hossain MM showed in his study that mean duration was 11.7 ± 8.22 days[18].

The value of surfactant in improving outcome of neonates with RDS, decreasing the length of ventilation and decreasing the incidence of some complications has been previously documented[27,25]. Surfactant was used for four patients of RDS in this study and three babies were survived and they required very short duration of mechanical ventilation.

Conclusion

Mechanical ventilator is one of the major interventions which provide life saving support for neonates with respiratory disorder. In this study the most common indication of MV was respiratory distress syndrome followed by perinatal asphyxia and septicemia. The survival rate was 56.70%. Septicemia and PNA was the leading cause of death in this study. Strict aseptic precaution must be maintained to reduce the septicemia for better outcome. During mechanical ventilation proper monitoring of vital parameter and intake output are also important for favorable outcome.

Disclosure

All the authors declared no competing interest.

References

1. Ali MB, Maruf AA, Rashid MM. Pattern and outcome of admissions in a neonatal high dependency unit of a medical college hospital in Khulna, Bangladesh. Medscape. 2018; 5(2):1-7.

2. UNICEF, WHO, The World Bank, UN: Levels and Trends in Child Mortality Report. 2015.

3. UNICEF/WHO/The World Bank/UN Pop Div. Levels and Trends in Child Mortality. Report. 2013.

4. Requejo J, Victora C, Jennifer B. A decade of tracking progress for maternal, newborn and child survival, Countdown to 2015. The Lancet. 2015; 466-476.

5. Prabha PC, George RT, Francies F. Profile and outcome of neonates requiring ventilation:The Kerala experience. Curr Pediatr. 2014; 18(2):57-62.

6. Hossain MM, Amin MR, Akber MS. Mortality determinants among critically ill newborns treated in intensive care unit. Dhaka Sishu Hospital Journal. 2000; 16(1): 5-8.

7. Tribedi S, Chudasama R, Srivastava A. Study of early predictors of fatality in mechanically ventilated neonates in NICU. Journal of Health and Allied Sciences. 2009; 8(3):1-4.

8. Kessler M. State of the art in conventional mechanical ventilation. J Perinatol. 2009; 29(4):262–275.

9. Truog WE. Complications of mechanical ventilation and airway control in the neonate. Respir Care. 1986; 31:498-505.

10. Nangia S, Saili A, Dutta AK, Gaurvani MS, Kumari S. Neonatal mechanical Ventilation. Experience at a level II care Centre. Indian J Pediatr. 1998; 65: 291-296.

11. Gurubacharya SM, Aryal D, Misra M, Gurung R. Short-Term Outcome of Mechanical Ventilation in Neonates. J. Nepal Pediatrics. 2011; 31(1): 35-38.

12. Dutt RD, Dutt C, Ambey R. Neonatal Mechanical Ventilation-Early experiences in central India. International Journal of Medical Research and Review. 2014; 2(4):319-323.

13. Greenbush A, Milner AD. Acute respiratory disease. In: Roberton NRC, editor. Textbook of Neonatology. 4th ed. China: Elsevier Churchill Livingstone. 2005;468-553.

14. Tortman H. The Neonatal Intensive Care Unit at the University Hospital of the West Indies: The first few years' experience. West Indian Med J. 2006; 55 (2): 75-79.

15. Hossain MM, Shirin M, Mamun AM, Hassan AN, Shahidullah M. Predictors of Mortality in Ventilated Neonates in Intensive Care Unit. Bangladesh J Child Health. 2009; 33 (3): 78-79.

16. Kishan I, Valdez J, Mir NA, Elzouki AY. Mechanical ventilation in newborn infants. Afr J Med Sci. 1988; 17: 83-88.

17. Mathur NC, Kumar S, Prasanna AL, Sahu UK, Kapoor R, Roy S, et al. Intermittent positive pressure ventilation in a neonatal intensive care unit: Hyderabad experience. Indian Pediatr. 1998; 35: 349-353.

18. Hossain MM, Amin MR, Akbar MS. Predictor of outcome among critically ill newborns treated in intensive care unit (ICU). Dhaka Shishu hospital journal. 2000; 16(1): 6-9.

19. Singh M, Deorari AK, Paul VK, Mittal M, Shankar S, Munshi U, et al. Three years' experience with neonatal ventilation from a tertiary care hospital in Delhi. Indian Pediatr. 1993; 30: 783-789.

20. Diwakar KK. Ventilation strategies in neonates with respiratory distress. Indian Journal of Paediatrics. 2005; 7(4):273.

IAHS Medical Journal
Volume 04 Issue 01 June 2021; 27-32

21. Daily WJR, Nortway WH. Perspective in mechanical ventilation of the newborn. Pediatrics. 1991; 18: 253-261.

22. Riyas PK, Vijayakumar KM, Kulkarni ML. Neonatal mechanical ventilation. Indian J Pediatr. 2003; 70: 537-540.

23. Kambarami R, Chidede O, Chirisa M. Neonatal intensive care in a developing country: Outcome and factors associated with mortality. Cent Afr J Med. 2000; 46: 205-207.

24. Maiya PP, Vishwanath D, Hegde S, Srinivas TP. Mechanical ventilation of newborn, experience from a level III NICU. Indian Pediatrics. 1994; 32(12): 1275-1280.

25. Lindroth M, Svenningsen NW, Ahlstrom H, Johnson B. Evaluation of mechanical ventilation in newborn infants. Actra Padiatr Scand. 1998; 69: 143-149.

26. Iqbal Q, Younus MM, Ahmed A. Neonatal mechanical ventilation: Indications and outcome. Indian J Crit Care Med. 2015; 19(9): 523–527.

27. Jahan N, Haque ZSM, Mannan MA, Nasrin M,Afroze F, Anwar P et al. Indication and short term outcome of Mechanical Ventilation in Neonates in a tertiary care hospital. Bangladesh Journal of Medical Science. 2017; 16: 24-28.