Short-Term Outcome of Mechanical Ventilation in Neonates

Gurubacharya SM[1], Aryal DR[2], Misra M[3], Gurung R[4]

[1]Dr. Simmi Misra Gurubacharya, MBBS, MD, Registrar, Assistant Professor (NAMS), [2]Dr. Dhana Raj Aryal, Consultant Pediatrician and Neonatologist, [3]Dr. Megha Mishra, MBBS, Medical Officer, [4]Dr. Roshma Gurung, MBBS, Medical Officer, NICU, All from the Paropakar Maternity and Women's Hospital, Thapathali, Kathmandu, Nepal

Address for Correspondence: Dr. Simi Misra Gurubacharya, E-mail: *sm_pul@rediffmail.com*

Abstract

Mechanical ventilation of newborn has been practiced for several years with several advances made in the way. As compared to the Western world and our neighbouring countries, neonatal ventilation in our country is still in its infancy. **Objectives:** To analyze the common indications and outcome of neonates requiring mechanical ventilation. **Methods:** This was a prospective observational study conducted on neonates requiring mechanical ventilation within first 24 hours of birth over a period of nine months. **Results:** Birth asphyxia was the commonest indication for ventilation (59.67%) followed by asphyxia with meconium aspiration syndrome (MAS) (17.74%), hyaline membrane disease (HMD) (8.06%), MAS (6.45%) and intrauterine pneumonia (6.45%). Out of 62 babies, 22 (35.48%) survived. Babies with asphyxia had highest survival rate (51.35%). Neonates with HMD did not survive. Term babies and babies weighing ≥2500g had higher survival rate of 40.47% and 41.46% respectively, while babies less than 32 weeks had survival rate of 16.66% only. **Conclusions:** Mechanical ventilation reduces the neonatal mortality; hence, facilities for neonatal ventilation should be included in the regional and central hospitals providing level II neonatal care.

Key words: neonatal ventilation, hyaline membrane disease, low birth weight

Introduction

Mechanical ventilation of newborn has been practiced for several years with several advances made in the way. It was introduced in 1960s to support the infants with respiratory failure. Mechanical ventilation may be immediately required in multiple conditions of a sick newborn. This has contributed to the rapid decline in neonatal mortality in various parts of the world. As compared to the Western world and our neighbouring countries, neonatal ventilation in our country is still in its infancy. The basic infrastructure and expertise to ventilate newborn is lacking in majority of the hospitals. Hence, there is a scanty data on neonatal ventilation in Nepal. The study was done to find out the indications and outcome of neonates requiring mechanical ventilation in first 24 hours of birth.

Materials and Methods

This was a prospective study done from January 2009 to September 2009. Sixty two newborns were enrolled requiring mechanical ventilation within first 24 hours of birth. Babies with severe congenital anomalies were excluded. All neonates were born in our hospital. The neonate's birthweight, gestational age, apgar score, age of onset of respiratory distress, time of intubation and extubation, course of illness and cause of death were recorded. Outcomes of main interest were:

1. Common conditions requiring mechanical ventilation.
2. Survival of ventilated babies (NICU mortality).
3. Survival rate in different clinical conditions.
4. Survival rate in relation to birth weight and gestational age.

All the ventilated babies were nursed under servo controlled open care system. They were continuously under monitor for heart rate, respiratory rate, temperature, ECG, blood pressure and oxygen

saturation. They were diagnosed by standard criteria for asphyxia[1], meconium aspiration syndrome (MAS)[2], hyaline membrane disease (HMD)[2], intrauterine pneumonia[3] and congenital heart disease[4].

The indications for IPPV were

(i) Respiratory distress with failure to maintain arterial blood gases (ABGs) under head-box or mask with FiO2 of 0.6-0.8 (pH<7.2 and/or PaCO2>60mmHg and/or PaO2<50mmHg)

(ii) Prolonged/recurrent apneic spells and

(iii) Downes' score (5) >6.

The ventilator used was time-cycled, pressure limited continuous flow ventilator (Scherist, Infant Ventilator, Model. Millenium, ClassI, Type B). The objective was to ventilate the babies effectively (maintaining normal ABGs with minimal work of breathing) with minimal ventilator settings. Oxygen saturation was maintained between 87-93%. Septic screening was done in all babies. First line antibiotics used were cefotaxime and amikacin. Other drugs (eg. vancomycin, ceftazidime, meropenem, dopamine, phenobarbitone, frusemide) were used when required.

Results

A total of sixty two babies were mechanically ventilated. There were 41 males and 21 females (ratio 2:1). The mean birth weight and gestational age were 2588.95g (range 950-3800g) and 37.4 weeks (28-42wks) respectively. Out of 62 babies, twenty two (35.48%) survived. Table 1 shows the survival of ventilated babies in relation to birth weight. The maximum number of ventilated babies was in the group weighing ≥2500g (66.13%). Table 2 shows the survival of ventilated babies in relation to gestational age. Neonates of more than 32 weeks and less than 37 weeks had 30.76% of survival rate in comparison to survival rate of 16.66% in those less than 32 weeks of gestation. Full-term babies had 40.47% of survival rate. Table 3 shows the indications for mechanical ventilation and survival in different clinical conditions. Perinatal asphyxia contributed to the maximum number (59.68%). There was one case of cyanotic congenital heart disease which did not survive. Only one case of asphyxia with MAS survived (9.09%), while nineteen cases (51.35%) of asphyxia survived out of thirty seven babies. HMD contributed to 8.06% of cases followed by MAS and intrauterine pneumonia (6.45% each). None of the babies with HMD survived.

Table 1: Survival of ventilated neonates in relation to birth weight.

Weight(g)	Ventilated: Number (%)	Survived: Number (%)
<1000	1(1.62%)	0(0%)
1000-1499	4(6.45%)	1(25%)
1500-1999	8(12.9%)	2(25%)
2000-2499	8(12.9%)	2(25%)
≥2500	41(66.13%)	17(41.46%)
Total	**62 (100%)**	**22(35.48%)**

Table 2: Survival of ventilated neonates in relation to gestational age

Gestation Age (wks)	Ventilated: Number (%)	Survived: Number (%)
< 28	1(1.62%)	0(0%)
28<32	6(9.68%)	1(16.66%)
32<37	13(20.96%)	4(30.76%)
≥37	42(67.74%)	17(40.47%)
Total	**62(100%)**	**22(35.48%)**

Table 3: Indications and survival in different clinical conditions

Indications	Ventilated n (%)	Survived n (%)
Asphyxia	37(59.68%)	19(51.35%)
Asphyxia with MAS	11(17.74%)	1(9.09%)
HMD	5(8.06%)	0(0%)
MAS	4(6.45%)	1(25%)
Pneumonia	4(6.45%)	1(25%)
Others	1(1.62%)	0(0%)
Total	**62 (100%)**	**22(35.48%)**

Discussion

The survival rate of ventilated babies was 35.48%. The survival rate in different studies in different parts of the world were 48.76%[6], 55.5%[7], 51%[8], 46.54%[9], 53%[10], 43.9%[11] and 52.9%[12] respectively. However, these different studies also included CPAP as the mode of ventilation whereas we used it if required during weaning only. The maximum number of ventilated babies falls in the group weighing ≥2500g (66.13%). The survival rate (41.46%) was also high in this group. Survival in all the babies between 1000g to 2499g was 25% only. This result is not in accord with other studies[9,13] demonstrating increase in survival with increasing birth weight, although the babies in the group weighing ≥2500g had higher survival rate. This result may be because of the small sample size of our study. Though the number of admissions was more, but due to

the limited numbers of ventilators other babies fulfilling the criteria could not be included. The study documents the increase in survival rate with increasing gestational age with maximum survival rate in the full term babies (40.47%). Babies less than 32 week had survival rate of 16.66% while other studies had shown 25%-32% of survival rate[8,13]. In another study, the survival rate of babies with gestational age more than 37 weeks was 50.2%[9].

Almost 34% of low birth weight babies (LBW) required mechanical ventilation within first 24 hours of birth. Out of all the LBW babies, 23.8% survived as compared to 41.46% of babies in the group of ≥2500g. Our one newborn of gestation less than 28 weeks and weighing 950g kept on ventilator did not survive. Sepsis is a major complication leading to high mortality and poor survival of LBW babies. Also, neonates on ventilator require extra care and monitoring which in our set up is quite difficult due to discrepant ratio between neonates and nursing staff.

Perinatal asphyxia was the main indication of ventilation followed by asphyxia with MAS (17.74%), HMD (8.06%), MAS (6.45%), congenital pneumonia (6.45%) and congenital heart disease (1.62%). Asphyxia was the main indication of ventilation in one of the study[8]. However in majority of the other studies, HMD was the main indication of ventilation[6,7,9,11,12]. The survival rate for asphyxia was 51.35% while the other studies show 31.8%[6], 66.6%[14], 42%[8], 27.2%[13], and 46%[10] of survival rate. None of the babies with HMD survived. Two babies who were successfully extubated expired on day five and six of life due to nosocomial sepsis. The outcome of HMD in other studies ranged from 11.1% to 53.1%[8,12,13,14]. The reasons for the poor outcome of HMD and low LBW survival can be (i) lack of surfactant therapy, (ii) high rate of nosocomial infection, (iii) lack of other modes of assisted ventilation, (iv) organ immaturity of very low birth weight and extremely low birth weight babies and (v) lack of effective monitoring while on ventilator. Other studies have also shown the risk factors for poor outcome are birth weight <2000gm, prematurity and late referrals to NICU[11].

Babies with MAS and asphyxia with MAS too had poor survival rate. The late referral of mothers and delayed diagnosis of fetal distress lead to severe asphyxia and meconium aspiration which further contribute to persistent pulmonary hypertension of newborn (PPHN) leading to high mortality. Use of high frequency ventilation, NO and ECMO could decrease the morbidity and mortality if available.

The present time is switching to noninvasive modes of ventilation. We still are a century behind in the mechanical ventilation. Because of the lack of nasal CPAP we could not include CPAP as mode of ventilation in our study which certainly would have changed the survival rate. Still judicious use of IPPV improves the outcome in babies having RDS and MAS. Use of IPPV has certainly increased the survival rate in different clinical conditions wherever required. Ventilation has to be used in the early part of illness before the start of metabolic complications or organ damage. Also, aspesis is to be maintained strictly, otherwise it makes all our effort in vain.

For the improved outcome i.e. to decrease the morbidity and mortality of newborns requiring ventilator care, we need to improve our resources and neonatal intensive care services with an appropriate ratio between sick neonate and medical staff.

The aim of ventilation is not only to decrease the morbidity and mortality but also to be used judiciously to prevent the complications. To decrease our neonatal mortality, we require assisted ventilation which is a team effort of skilled, devoted doctors and nursing staff and as we gain experience in the ventilation our outcome would also improve.

Conclusion

Mechanical ventilation reduces the neonatal mortality; hence, facilities for neonatal ventilation should be included in the regional and central hospitals providing level II neonatal care.

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