Original article:

Indication and short term outcome of Mechanical Ventilation in Neonates in a tertiary care hospital

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Abstract:

Background: Mechanical ventilation of newborn has been practiced for several years with advances in many ways. As compared to the western world, neonatal ventilation in our country started in recent years. ***Subjects, Methods and Results:*** A retrospective chart review was conducted to analyze the common indications and outcome of neonates requiring mechanical ventilation in neonatal intensive care unit at Ad-Din Medical College Hospital from January 2012 to July 2013. Fifty eight neonates were ventilated over a period of 19 months of whom 39 (67.24%) survived. Respiratory distress syndrome was the commonest indication for ventilation (32.75%), followed by Perinatal asphyxia (18.96%), Pneumonia (13.79%), Neonatal Sepsis (13.79%), Meconium aspiration syndrome 6(10.16%) & Pneumothorax 6 (10.16%). Among the babies who survived, 35(89.74%) were managed solely with conventional ventilator and 4 babies required both conventional and High Frequency Oscillatory (HFOV) ventilation. Survival rate was higher where birth weight >2500gm (76.19%) and gestational age 34-37 weeks (88.88%). Survival rates was (69.23%) in <30 weeks and 60% in <1000 g. Prolong ventilator support was needed for Respiratory Distress Syndrome without surfactant (mean 254 hrs), Perinatal asphyxia (mean 187hrs) and Neonatal sepsis (mean 187hrs). Common complications were Pneumonia (12.06%), Pneumothorax (10.34%), sepsis (8.6%) & Pulmonary hemorrhage (3.4%). Survival rate was higher in babies requiring mechanical ventilation for respiratory distress syndrome (84.21%). ***Conclusion:*** Use of surfactant could decrease the duration of ventilation and mortality further in babies with respiratory distress syndrome.

Key words: Mechanical ventilation; Respiratory distress syndrome; Surfactant

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Introduction

Before the 1960s newborn infants with severe lung disease, usually due to respiratory distress syndrome (RDS), had a very high mortality rate [1]. There has been a dramatic fall in neonatal mortality in developed countries with the advent of mechanical ventilation and the concept of neonatal intensive care[2–4]. The decrease in mortality has been even more impressive for very low birth weight infants (< 1500g)[5–7]. This has been attributed to the increased availability of mechanical ventilation, and more recently the introduction of surfactant and total

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parenteral nutrition (TPN)[8, 9]. Neonates with life-threatening conditions require the critical care services provided by modern neonatal intensive care units (NICU). Ventilatory support is essential for NICU care[10-13]. More than half of the approximately 7.5 million infant deaths in the world occur in the first four weeks after birth[14]. Mechanical ventilation of the neonate has been used widely and has become a routine procedure in neonatal intensive care units (NICU) in the Western world[15]. Neonatal mechanical ventilation is probably the single most important factor contributing to the rapid decrease in neonatal mortality within the last two decades[16]. Babies with Perinatal hypoxia and birth asphyxia as well as critically sick babies who develop life threatening apnea or cardiovascular collapse need mechanical ventilation. Neonates with progressive respiratory distress with impending respiratory failure and tiring respiratory muscles, can be supported and saved by assisted ventilation facilities[17]. Objective of the study to understand factors associated with use of ventilators, outcome, complications and duration of ventilation among neonates admitted in neonatal ICU in developing countries like Bangladesh.

Materials and Methods:

A prospective study based on hospital files was conducted in Neonatal ICU of Ad-din Hospital over 19 months from 1st January '2012 to 31st July' 2013. Among the neonates who were admitted in neonatal ICU during the study period those who were consecutively put on ventilator were enrolled in the study. Those who had lethal congenital anomaly were excluded. Total 58 neonates were put on ventilator during study period and were enrolled for the study. Age of neonates at the time of admission, sex, gestational age at the time of birth, underlying medical conditions, birth weight, mode of delivery, place of birth, duration of ventilator support and outcome were studied. Informed consent was taken from parents of neonates. Data were collected from hospital files using a prescribed format. Data were tabulated by frequency distribution tables and analyzed using proportions and chi square tests. All admitted neonates were subjected to arterial blood gas analysis along with a set of investigations to look for pulmonary maturity, infections, renal function, hyperbilirubinaemia, intraventricular hemorrhage. Neonates were kept on Conventional ventilator and on high frequency oscillatory ventilator (HFO) when required. Ethical approval was taken from ethics committee of Ad-din Hospital prior the study.

Results

During the study period, a total of fifty eight babies were mechanically ventilated. Out of 58 babies, 39 (67.24%) survived. There were 38 male and 20 female (ratio 1.9:1). The mean birth weight and gestational age were 2264 gm (800-3900g) and 34 wks (27-39 wks) respectively. Table 1 shows the survival of ventilated babies in relation to gestational age, birth weight and place of delivery. Thirty nine (67.24%) were born in our hospital (inborn) of whom twenty nine (80.55%) survived. Survival was low in out born babies 10(52.61%). Survival rate was higher among babies with birth weight >2500g 16 (76.19%) and gestational age 34-37 weeks 8 (88.88%). Survival rate was 9 (69.23%) among babies with gestational age <30 weeks and 60% with birth weight <1000g. Among the babies who survived 35(89.74%) were managed solely with conventional ventilator and 4 babies required both conventional and HFO ventilation.

Table 1: Outcome of babies ventilated in the NICU by birth weight, gestational age & place of delivery

GA (wks)	Survival (%)	Expired (%)	Total
< 30	9 (69.23%)	4(30.76%)	13(22.41%)
30-33	5(62.5%)	3(37.5%)	8(13.79%)
34-37	8(88.88%)	1(11.11%)	9(15.51%)
>37	17(60.71%)	11(39.28%)	28(48.27%)
Weight			
500-999	3(60%)	2(40%)	5(8.62%)
1000-1499	9(69.23%)	4(30.76%)	13(22.41%)
1500-2499	11(57.89%)	8(42.10%)	19(32.75%)
2500	16(76.19%)	5(23.80%)	21(36.20%)
In born	29 (74.35%)	10 (25.64%)	39 (67.24%)
Out born	10(52.63%)	9(47.36%)	19 (32.75%)

Table 2 shows various parameters like indications, and immediate outcome of mechanically ventilated neonates. Respiratory distress syndrome (32.75%) was most common indications for mechanical ventilation which was followed by severe birth asphyxia (18.96%), Pneumonia (13.79%), N. sepsis (13.79%), Pneumothorax (10.16%) and Meconium aspiration syndrome 6 (10.16%). Survival rate was higher in babies requiring mechanical ventilation for respiratory distress syndrome (84.21%). Survival rate was lowest among babies

with in N. sepsis & Perinatal asphyxia 27.27% Prolong ventilator support was needed for RDS without surfactant (mean 254 hrs), Perinatal asphyxia (mean 187hrs) and N. sepsis (mean 187hrs). Common ventilator associated complications were Pneumonia (12.06%), Pneumothorax (10.34%), Sepsis (8.6%) & Pulmonary hemorrhage (3.4%).

Table 2: Outcome of babies ventilated in the NICU by indication for ventilation

Reason for ventilation	Survival (%)	Expired (%)	Total
Respiratory distress syndrome	16 (84.21%)	3 (15.78%)	19 (32.75%)
Perinatal asphyxia	3 (27.27%)	8 (72.72%)	11 (18.96%)
Pneumonia	8 (100%)	0	8 (13.79%)
Neonatal Sepsis	4 (50%)	4 (50%)	8 (13.79%)
Meconium aspiration syndrome	4 (66.66%)	2 (33.33%)	6 (10.16%)
Pneumothorax	4 (66.66%)	2 (33.33%)	6 (10.16%)
Total	39 (67.24%)	19 (32.75%)	58 (100%)

Table 3: Distribution of neonates based on duration of ventilator support

Duration of ventilator support	No	Survived	Expired
<24 hrs	8 (13.79%)	3 (37.5%)	5 (62.5%)
1-7 days	27 (46.55%)	19 (70.37%)	8 (29.62%)
8 days- 1 month	23 (39.65%)	15 (65.21%)	6 (46.15%)
Total	58 (100%)	39 (67.24%)	19 (32.75%)

Table 4: Association of indication of ventilation with Mean weight, Gestational age and duration of ventilation

Disease	No	Weight	Gestational age	Duration of ventilation (days)
RDS	19	1428 (800-3600)	31.76 (27-36)	10.61 (1-22)
Perinatal asphyxia	11	2545 (1700-4700)	36.36 (28-40)	7.8 (1-22)
Pneumonia	8	2547 (1400-3300)	36.71 (32-38)	7.7 (1-18)
Neonatal sepsis	8	1455 (950-3500)	34.42 (29-38)	7.8 (1-18)
MAS	6	2883 (1900-3600)	38.5 (38-40)	6.6 (1-14)
Pneumothorax	6	2466 (2000-3000)	38.5 (38-42)	4.5 (1-10)
Total	58	2220 (1458-3076)	36.04 (32-39)	7.5 (1.5-17.33)

Table 5: Outcome of babies ventilated in the NICU by complications

Complications	Survived	Expired	Total
Pneumonia	6 (85.7%)	1 (14.28%)	7 (12.06%)
Pneumothorax	3 (50%)	3 (50%)	6 (10.34%)
Neonatal Sepsis	3 (60%)	2 (40%)	5 (8.6%)
Pulmonary Hemorrhage	1 (50%)	1 (50%)	2 (3.4%)

Discussion

The survival rate of 67.24% noted in this study for neonates ventilated in the NICU, though less than that quoted for developed countries (91%)[18], higher than that quoted for other developing countries (46-54%)[19-21]. Differences in mortality of ventilated neonates between developed and developing countries may be related to the transport facility, ready availability of surfactant and parenteral nutrition in developed countries as compared to the developing countries.

In the present study, 63.79% of cases were having low birth weight. Out of 18 (<1500 gm) babies 12 babies alive (66.66%), and in babies >1500 g, 25 babies out of 40 babies (67.5%) alive. LBW is caused by preterm birth, IUGR, or both and is a major cause for neonatal mortality[22].

In the present study main indications for ventilator support were RDS 19(32.75%), Perinatal asphyxia 11(18.96%), Pneumonia 8(13.79%), N. sepsis 8(13.79%), Pneumothorax 6(10.16%) and

Meconium aspiration syndrome 6(10.16%). In a study done by Krishnan et al, among 68 neonates who were managed with ventilator support, main indications for ventilation were infections (30.9%), hyaline membrane disease (23.5%), problems related to asphyxia (16.2%), apnea of prematurity (14.7%) [23].

Condition associated increased mortality in this study were PNA and neonatal sepsis. This is not unexpected, as Perinatal asphyxia which causes hypoxic ischemic encephalopathy results from anoxic injury to the brain and the prognosis for severely affected infants who would be the ones requiring ventilation is extremely poor, this is also true for neonates with sepsis, which causes multi organ failure.

Respiratory distress syndrome, a condition almost exclusively seen in the premature infant, was the most common. The survival rate for Hyaline Membrane Disease (HMD) was 84.21%. Singh et al[24] have reported 53% survival for these babies. Exogenous surfactant therapy has been shown to reduce the mortality rate, requirements for mechanical ventilation and air leak complications in HMD[25]. We used it only 8 of our patients because of the high cost and difficulty in procuring it on time.

The mortality rate in this study is complicated by these infants who have a poor prognosis by virtue of their primary diagnosis who are placed on a ventilator as part of a terminal resuscitative effort. These infants succumb to complications of their disease process, on which mechanical ventilation may have very little impact. In this study, there was 8 such patient with Hypoxic Ischemic Encephalopathy (HIE) stage III.

From this study, it is seen that the premature infant with RDS places the greatest demand on the resources of the NICU. They have the greatest utilization of ventilation, they are more likely to die, they require prolonged periods of ventilation and they have a higher incidence of complications. If the NICU at Ad-Din hospital is to be a financially sustainable entity, the premature, very low birth weight (VLBW) infant has to be targeted. The focus should begin with obstetric measures for the prevention of preterm delivery, close monitoring of high risk pregnancies and judicious use of tocolytics.

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[26]. Although surfactant is available in this setting it is not accessible to the majority of patients because of cost. Means of increasing accessibility of this drug needs to be explored for the future as in the long term; surfactant use will lead to decreased expenditure. We used surfactant in 8 babies with RDS and 7 babies of them survived.

Another area to be considered is the nutritional needs of the VLBW infants. Nutrition plays a major role in the survival of these infants and the inability to support them totally with parenteral nutrition is a factor that limits outcome. Although we used Total Parenteral nutrition in some of our VLWB, there is a need for the development of a total parenteral nutrition programme in the neonatal unit. Again the results of this study can be used to justify to policy makers the necessity for the parenteral nutrition on the hospital formulary.

Pneumonia & Pneumothorax were the common complications of mechanical ventilation followed by Neonatal sepsis and pulmonary hemorrhage. Pulmonary air leaks were the commonest complication in Western literature[27]. High peak and mean airway pressures and prolonged inspiratory time[28] are implicated as important factors causing air leaks. Pulmonary air leaks were, however, uncommon and found only in four neonates. It was often difficult to determine whether complications like pneumonia and air leaks in Meconium Aspiration Syndrome (MAS) are related to mechanical ventilation per se or occur as a part of the natural course of the disease. As the complications are important causes of death, early diagnosis and judicious management of these complications is important.

Conclusion:

Judicial use of neonatal intensive care measures in a developing country can result in a reduction of morbidity and mortality. Outcome of baby expose to mechanical ventilator depends on weight of baby, gestational age, primary diagnosis, and use of surfactant and total parenteral nutrition in preterm babies. The majority of baby kept in mechanical ventilator are secondary to preterm baby, birth asphyxia, MAS and Neonatal sepsis. Reducing the number of preterm delivery and preventing, recognition and management of birth asphyxia, sepsis and other risk factor will improve the outcome.

Conflict of interest: None

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