

Complications following ventilation therapy in newborn babies at tertiary health centre with special reference to broncho-pulmonary dysplasia

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Abstract

Background: Neonatal survival has increased after evolution of ventilation therapy in the last decade. Currently the major concerns are to prevent complications associated with ventilator therapy.

Objectives: To do a prospective study of all ventilated newborns and assess all aspects associated with complications.

Method: Observational study was carried out at Rukmani Chainani Maternity and Neonatal Unit (Intramural Neonatal Intensive Care Unit) and Extramural Neonatal Intensive Care Unit (Em-Nicu) in Sir Sayajirao General Hospital from January to October 2019. Study was done on 224 newborns who required ventilation therapy.

Results: Of the 224 newborns, 24 (10.7%) developed broncho-pulmonary dysplasia (BPD). Average birth weights of babies with and without BPD were 2.15kg and 2.06kg respectively. Most favourable outcome was in newborns with meconium aspiration syndrome with a discharge rate of 47.9%. Next favourable outcome occurred in newborns with pneumonia requiring ventilator therapy with a discharge rate of 43.5%. There were no cases of BPD among the 24 preterm babies whose mothers were given antenatal steroids. On the other hand, among the 81 preterm babies whose mothers were not given antenatal steroids, 11 (13.6%) developed BPD. Incidence of BPD was 5.2% in newborns who required mechanical ventilation for 0-3 days, 25% in newborns who required mechanical ventilation for 4-7 days, 59% in newborns who required mechanical ventilation for 8-14 days and 83.3% in newborns who required mechanical ventilation for >14 days.

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Conclusions: In our study, there was no difference in incidence of BPD in normal birth weight and low birth weight babies. The present study showed that increased duration of mechanical ventilation was associated with an increase in the incidence of complications, especially BPD. Of those requiring ventilation therapy, MAS and pneumonia had more favourable outcomes compared to hyaline membrane disease.

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(Keywords: broncho-pulmonary dysplasia (BPD), meconium aspiration syndrome, hyaline membrane disease).

Introduction

The under-5-mortality rate in low-income countries was 68 deaths per 1000 live births in 2018 according to the World Health Organisation (WHO) data¹. According to WHO data the under-5-mortality rate in India was 38 deaths per 1000 live births¹. Infant mortality rate (IMR) plays a major role in under-5-mortality rate. A sample registration survey bulletin, released by home affairs in 2017 showed that the IMR in India was 34 per 1000 live births¹. India has reduced its IMR from 57 per 1000 live births in 2006 to 34 per 1000 live births in 2017¹. In IMR, the highest deaths occur in the neonatal period. The neonatal mortality rate in India was 25.4 deaths per 1000 live births in 2016.

Deaths due to respiratory distress syndrome (RDS) were greatly reduced after surfactant therapy with ventilation, deaths due to meconium aspiration syndrome (MAS) were greatly reduced after treatment with milrinone and sildenafil and deaths due to birth asphyxia were greatly reduced after ventilator therapy with multi-organ care and shock management. Neonatal survival has increased after evolution of ventilator therapy in the last decade. Deaths due to RDS, MAS and severe birth asphyxia have decreased to a large extent. After increasing survival, major concerns are to prevent complication associated with ventilator therapy. Barotrauma, ventilator associated pneumonia, and broncho-pulmonary-dysplasia (BPD) are the major ones. Complications following ventilator therapy can be prevented by close monitoring of child and ventilator parameters, early shift of child to non-invasive ventilation therapy and early extubation as

much as possible according to a few studies². There are no studies available which explore the correlation of duration of ventilator therapy and ventilator settings with the incidence of complications and outcome and whether other factors play any role in ventilator therapy associated complications.

Objectives

Present study was undertaken to look at all parameters which are associated with ventilator therapy complications. As BPD has long term morbidity more focus was given to it.

Method

An observational study was conducted in the Department of Paediatrics, Sir Sayajirao General Hospital and Medical College Baroda, from January to October 2019 including newborns admitted at intramural NICU (IM-NICU) and extramural NICU (EM-NICU). It was an observational study with a total of 224 newborns who required some sort of ventilator therapy.

As the average number of newborns who remain on ventilator therapy was 20 per month after removing exclusion criteria, and as this study was of 10 months duration, the estimated sample size was 200. However at the end of the 10 month study period the total number who received ventilation was 224.

Inclusion criteria: All term (37 completed weeks – 42 weeks) and preterm (less than 37 weeks) and post-term neonates admitted at IM-NICU & EM-NICU requiring ventilator therapy.

Exclusion criteria: Newborns having major congenital malformations.

Enrolments: From January to October 2019, subsequent to obtaining consent from relatives, newborn were admitted to IM-NICU & EM-NICU for any illness that required ventilator therapy.

Initial assessment of a subject involved detailed history, emphasizing on sex, maternal infection, gestational weeks, birth weight, type of amniotic fluid, history of antenatal steroids present or not, resuscitation required at birth or not.

Ethical issues: Ethical Approval was obtained from the Institutional Ethics Committee for Human Research (IECHR), Medical College and SSG Hospital, Baroda, Gujarat, India (No. ECR/85/Inst/GJ/2013/RR-16). Written informed consent was taken from the parents of the neonates.

Statistical analysis: As this is an observational study, simply comparing percentages of each group was used for analysis. Fisher test was used for comparing effect of antenatal steroid.

Results

The total number of ventilated babies during the study period was 224. In the present study 71 newborns were put on ventilator therapy for MAS of whom 31 (43.7%) expired. Of 59 newborns with birth asphyxia who required ventilation 29 (49.2%) expired. Of 23 newborns put on ventilator therapy for pneumonia, 9 (39.1%) expired. Of 86 newborns put on ventilator therapy for hyaline membrane disease, 56 (65.1%) expired. Of the 22 with other conditions requiring ventilation 14 (63.6%) expired. The mortality according to aetiology is shown in Table 1.

Table 1: Mortality according to aetiology

Aetiology	n (%)
Meconium aspiration syndrome	31 (43.7)
Birth asphyxia	29 (49.2)
Pneumonia	09 (39.1)
Hyaline membrane disease	56 (65.1)
Others	14 (63.6)

In the present study 116 (51.8%) newborns required mechanical ventilation for 0-3 days, 80 (35.7%) newborns required ventilation for 4-7 days, 22 (9.8%) newborns required ventilation for 8-14 days and 6 (2.7%) newborns required ventilation for >14 days. This is illustrated in Figure 1.

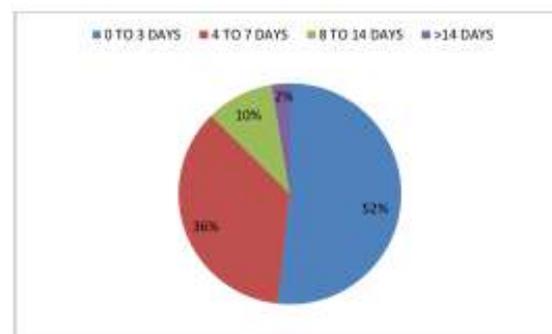


Figure 1: Duration of mechanical ventilation

Of the 116 newborns on ventilator for 0-3 days, 6 (5.2%) developed complications, including one with BPD. Of the 80 newborns on ventilator for 4-7 days, 20 (25%) developed complications, including 7 with BPD. Of the 22 newborns on ventilator for 8-14 days, 13 (59.1%) developed complications including 10 with BPD. Of the 6 newborns on ventilator for >14 days, 5 (83.3%) developed complications all 5 developing BPD. Figure 4 shows the average birth weights of newborns with and without BPD. This is illustrated in Figure 2.

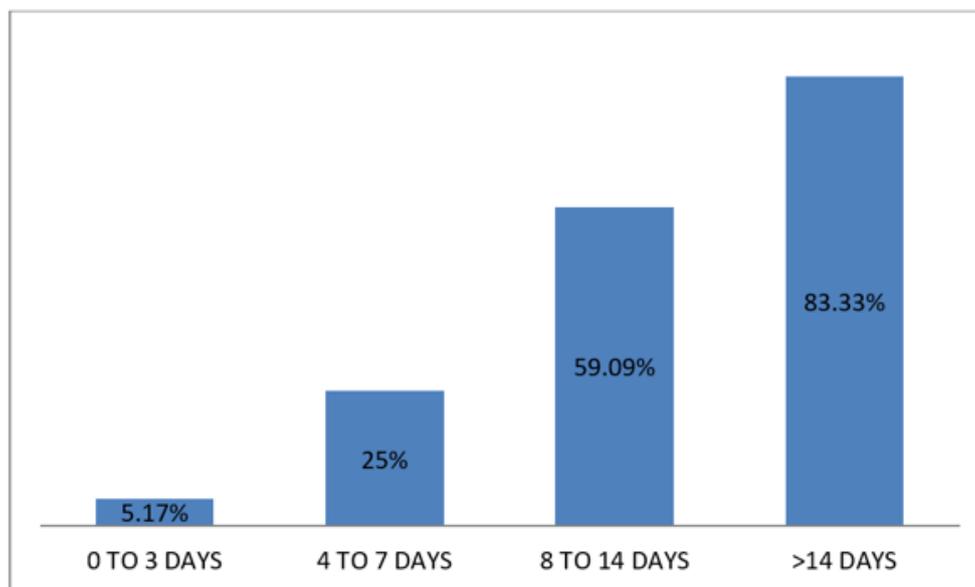


Figure 2: Newborns who developed complications

There was not much of a difference in the average weight of newborns with BPD. (2.15 kg) and

without BPD (2.06 kg). This is illustrated in Figure 3.

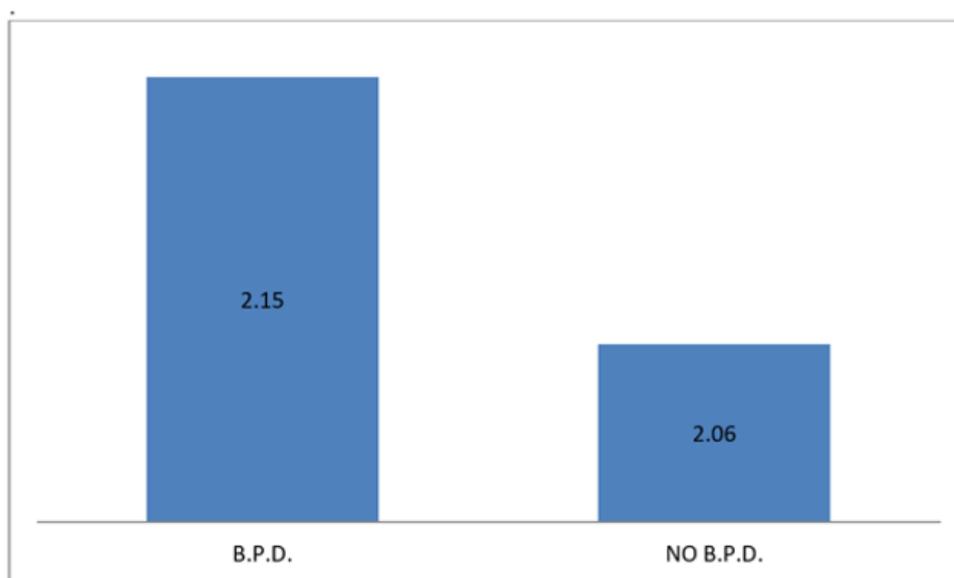


Figure 3: Average birth weight of newborns with and without bronchopulmonary dysplasia

In the present study mothers of 24 preterm newborns were given antenatal steroids. One newborn developed ventilator associated pneumonia (VAP). None developed BPD. Mothers of 81 preterm newborns were not given antenatal

steroids. Of them 11 (13.6%) developed BPD. This is shown in Table 1, which shows the association between antenatal steroids and occurrence of BPD in preterm newborns requiring ventilation.

Table 1

Association between antenatal steroids and occurrence of BPD in preterm newborns requiring ventilation

Antenatal steroids	Number	BPD present n (%)	BPD absent n (%)	*p-value
Given	24	0 (0)	24 (100)	0.0651
Not given	81	11 (13.6)	70 (85.4)	
Total	105	11	94	

*Fisher test was used as one of cells of the table contains a zero; $p < 0.05$ significant

Discussion

In the present study 71 newborns were put on ventilator therapy for MAS of whom 43.7% expired. Cleary GM, *et al*³ conducted a study in North America which showed a mortality ranging from 10 to 40% in MAS. A population based study of MAS in France by Fischer C, *et al*⁴ showed a nearly 11% mortality in severe MAS. In our study, of 59 newborns with birth asphyxia who required ventilation, 49.2% expired. A retrospective study done by Yelamali B, *et al*⁵ showed that 33 out of 163 newborns with birth asphyxia expired. Cause of the high mortality in the present study may be because asphyxiated newborn are admitted in a very poor general condition from outborn delivery. Further, some newborns are transferred from private hospitals in a very poor condition. Thus as ventilation requirement was present due to no respiratory drive or gasping respiration, all were considered hypoxic ischaemic encephalopathy (HIE) grade 3. Thus the present study shows that the chances of mortality increases as grade of HIE increases.

The present study shows that increased duration of mechanical ventilation is associated with an increase in the incidence of complications, especially BPD. In our study there was no difference in incidence of BPD in normal birth weight and low birth weight babies. The National Institute of Child Health and Human Development (NICHD) Neonatal Research Network data showed that among infants of gestational age 22 to 28 weeks, 42% had BPD, based on receipt of oxygen at 36 weeks' post menstrual age, 68% had BPD using severity based definitions, suggesting incidence is higher among low birth weight babies⁶. It is most probably because mortality is higher among very low birth weight (VLBW) and extremely low birth weight (ELBW) babies in the present study. In the present study because of prolonged ventilator requirement due to disseminated intravascular coagulation and pulmonary haemorrhage, the incidence of BPD in full term babies is higher. Present study also emphasizes that BPD is not a complication of only VLBW newborn. This indicates birth weight per se does not influence the incidence of BPD. The data shows that there was no case of BPD amongst 24 preterm babies where the mother was given antenatal steroids. On the other hand, there was an incidence of 13.6% in preterm neonates whose mothers received no antenatal steroids. However this was not statistically significant based on the Fisher exact test. Thus the present study fails to show any beneficial effect of antenatal steroids on

incidence of BPD. A larger sample size may be necessary to demonstrate this difference.

Conclusions

In our study, there was no difference in incidence of BPD in normal birth weight and low birth weight babies. The present study showed that increased duration of mechanical ventilation was associated with an increase in the incidence of complications, especially BPD. Of those requiring ventilation therapy, MAS and pneumonia had more favourable outcomes compared to hyaline membrane disease.

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