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Original Research Article

Study on effect of antenatal steroids on various outcomes in mechanical ventilated low birth weight neonates admitted to neonatal intensive care unit

Madhu G. N., Anil H.*

Department of Paediatrics, Kempegowda Institute of Medical Sciences, Bangalore, Karnataka, India

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***Correspondence:**
Dr. Anil H.,
E-mail: anil240866@gmail.com

ABSTRACT

Background: There has been an increase in morbidity in low birth weight infants, since the advancement in field of neonatology. Mechanical ventilation is one of the important life saving intervention in these babies and if prolonged, it is known to cause various morbidities like bronchopulmonary dysplasia, retinopathy of prematurity, vocal cord injury. In this study we want to know effect of antenatal steroids on assisting in early extubation and in minimising duration of ventilation and prevention of reintubations.
Methods: This study is a prospective observational study. The study was conducted in Kempegowda institute of medical sciences, Bangalore. Total of 60 low birth weight infants (<2500gm) who were admitted to the Neonatal Intensive Care Unit (NICU) and were on mechanical ventilator support were included in the study. The study was conducted for a duration of 18 months, between January 2019 to June 2020.
Results: Out of 60 cases 49 of neonates underwent successful extubation and 11 had failed extubation and were reintubated. Out of 49 successful extubation cases 18 mothers were not given antenatal steroids and 7 of them received 1 dose and 24 received 2 doses of betamethasone respectively. Among failed extubation group 7 mothers had not received steroids and 2 had received one and 2 doses respectively.
Conclusions: In this study, we were able to know the effect on antenatal steroids on duration of mechanical ventilation and also about their effect on extubation success.

Keywords: Antenatal steroids, Low birth weight neonates, Mechanical ventilation

INTRODUCTION

Recently the field of neonatology and newborn care have advanced and as a result there is decrease in the mortality with respect to low birth weight infants.[1-3] According to the recent survey out of all deliveries 1/4th of newborn are low birth weight.[4]

However these resuscitation methods leads to various morbidities and consequences.[5] In this study we are going to see the outcome of one such resuscitation method which is of atmost importance for survival of a newborn, which is mechanical ventilation.[6-7]

If ventilation gets prolonged they can be associated with complications and sequelae like BPD, subglottic stenosis, ROP, bronchial hyper-reactivity, abnormal hearing and also atelectasis, barotrauma and volutrauma.[8-10]

In this study we want to know effect of antenatal steroids on assisting in early extubation and in minimizing duration of ventilation and prevention of reintubations.

Antenatal steroids

As the field of neonatology is advancing there are more chances of survival of preterm babies. There are various measures to facilitate their survival by reducing the morbidities and complications. These measures can be antenatal also. One of the meaasure is antenatal corticosteroids.[11]

The effectiveness and impact of antenatal corticosteroids were initially done in animals during 1960s. From these studies it was noted that, use of antenatal corticosteroids resulted in accelerating the process of maturation and formation of organs and systems, especially in development of lungs.[12] In 1972, Liggins and Howie studied the use of antenatal corticosteroids and demonstrated that it will reduce the incidence of respiratory distress syndrome and also reduce the mortality rate in preterm neonates.[13]

Nevertheless, the result of such studies were not sufficient to bring changes in the obstetric practice about use of antenatal steroids. However the situation changed soon in 1990s, when Crowley et al. did a meta analysis by bringing together 12 good methodological studies.[14]

These studies involved almost 3000 newborns across various NICU setup and the results showed there was a reduction of 50% incidence of respiratory distress syndrome and 40% reduction in the mortality and also it was noticed that, there was also decrease in occurrence of peri-intra ventricular hemorrhage. In 1994, the national institutes of health, brought together the specialists involved in perinatology and brought a consensus regarding use of antenatal corticosteroids.[15] This was to stimulate the use of antenatal steroids on a wider platform in clinical practice.

Corticosteroids act on target tissues on specific protein receptors. They alter the gene expression in those target organs thus resulting in alteration in protein synthesis and deposition.[16] By this mechanism the corticosteroid aid in achieving transition from fetal life to extra uterine life and improved outcome of such neonates.[17-24]

This leads to accelerated maturation of lungs, thereby reducing the severity and incidence of respiratory distress syndrome.[14,25-27] The corticosteroids alter the structural and biochemical physiology of neonates, like surfactant production and lung maturation and thus reduces the requirement and duration of mechanical ventilation.[28-30]

It is also noted that in developed countries there is reduction in deaths from respiratory causes with use of corticosteroids.[31] Apart from beneficial effects in respiratory diseases the corticosteroids have beneficial effects on brain maturation and reduction in incidence of peri-intra ventricular hemorrhage and its severe forms that results in deleterious sequel in survivors.[14,25-27,32,33] In addition corticosteroids also provide stability to cardiovascular system and cause modification in renal functioning which are essential for survival of extremely preterm neonates.[34] Antenatal corticosteroids are known to influence all organs and organ system thereby reducing the complications and also ease the transition in premature neonates to survive in extra uterine environment.

In this study we want to know effect of antenatal steroids on assisting in early extubation and in minimizing duration of ventilation and prevention of reintubations.

METHODS

This study is a prospective study, an observational study. The study was conducted in Kempegowda institute of medical sciences, Bangalore. Total of 60 low birth weight infants (<2500gm) who were admitted to the Neonatal Intensive Care Unit (NICU) and were on mechanical ventilator support were included in the study.

Sample size calculation

Sample size calculated using open epi software, considering 95% confidence interval and 10% precision.

Formula

$4PQ/D^2$ …….4 [0.15 x 0.85]/0.1 x 0.1=50

The study was conducted for a duration of 18 months, between January 2019 to June 2020.

The outline of the study was presented to the institutional ethical committee and approval and clearance was obtained from the institutional ethics committee, the patients fulfilling the inclusion criteria were enrolled for the study.

Inclusion criteria

All low birth weight infants (<2500gm) who were intubated and on ventilator support. Previously extubated cases who were reintubated.

Exclusion criteria

Major congenital anomalies. Extubated as a part of withdrawal of care.

We included all LBW infants (<2500gm) who were intubated and who were on mechanical ventilation. Infants demographics (including birth weight (BW), gestational age (GA), gender, race, and Apgar scores at 1 and 5min) and prenatal characteristics (including prenatal steroids, maternal diabetes, chorio-amnionitis, and use of magnesium sulfate) were reviewed using case records. Then these infants were followed up for complications like retinopathy of prematurity, bronchopulmonary dysplasia, pneumothorax, seizures and abnormal hearing.

Statistical analysis

Descriptive statistics was used was statistical analysis. It included mean and inferential statistics (which include use of student t test and chi square test). Differences between the mean values of two continuous variables were tested using student T test and for categorical variables, chi square test was used to test significance of differences in proportion of two or more groups. Fischer exact test was used in place of chi square test wherever necessary. The p value of <0.05 was considered as significant. Med Calc statistical software tool was used to calculate various statistics in the study.

RESULTS

Out of 60 cases 49 of neonates underwent successful extubation and 11 had failed extubation and were reintubated. Out of 49 successful extubation cases 18 mothers were not given antenatal steroids and 7 of them received 1 dose and 24 received 2 doses of betamethasone respectively.

Among failed extubation group 7 mothers had not received steroids and 2 had received one and 2 doses respectively (Table 1).

Table 1: Use of antenatal steroids among successful extubation and failed extubation groups.

Prenatal steroids	Successful extubation	Failed extubation	P value
0 dose	18	7	0.145
1 dose	7	2	
2 doses	24	2	

Table 2: Comparing various complications with duration of mechanical ventilation.

Complications		Mechanical ventilation for 7 days or less	Mechanical ventilation for more than 7 days	P value
ROP	Yes	2	17	<0.00001
	No	37	4	
BPD	Yes	0	2	0.1186
	No	39	19	
Pneumothorax	Yes	2	2	0.6064
	No	37	19	
Abnormal OAE	Yes	0	7	0.0003
	No	39	14	
Reintubation	Yes	3	8	0.011
	No	36	13	

Table 3: Comparing various characteristics of cases with duration of mechanical ventilation.

Factors		Ventilated for <3days	3-7 days	7-14 days	>14 days	P value
Birth weight	<1000 gm	1	1	1	3	0.0982
	1000-1500 gm	7	6	9	1	
	1501-2000 gm	5	7	5	0	
	2001-2499 gm	5	7	2	0	
Gestational age	<29wk + 6days	8	5	8	2	0.3662
	30wk – 37wk +6 days	9	16	9	2	
	>38wk	1	0	0	0	
Gender	Male	10	11	11	3	0.776
	Female	8	10	6	1	
Maternal comorbidities	Yes	5	3	2	0	0.535
	No	13	18	15	4	
Surfactant	0	5	3	1	0	0.596
	1	2	4	2	0	
	2 or more	11	14	14	4	
Seizure	Yes	1	0	1	0	0.585
	No	17	21	16	4	
NEC	Yes	1	1	0	1	0.273

Continued.

Factors		Ventilated for <3days	3-7 days	7-14 days	>14 days	P value
	No	17	20	17	3	
Sepsis	Yes	10	9	13	4	0.07
	No	8	12	4	0	
Antenatal steroids	Yes	10	13	10	1	0.638
	No	8	8	7	3	
Postnatal steroids	Yes	18	21	17	4	-
	No	0	0	0	0	

Table 2 shows impact of prolonged ventilation on various adverse outcomes. It can be seen from table that ROP is noticed in 17 cases who were on ventilator for >7days to only 2 cases which were on ventilator for fewer than 7 days. Abnormal OAE is seen only in cases who were ventilated for more than 7 days. Reintubations were more common in neonates who were on ventilator for >7days and these findings were statistically significant. BPD was seen in 2 neonates both of them were on ventilator for more than 7 days.

Among the neonates who were extubated within 14 days 33 mothers had received antenatal steroids and 23 mothers had not received, in those group of babies who required ventilator support for more than 14 days 1 mother had received antenatal steroids and 3 didn't receive (Table 3).

DISCUSSION

Through this study effort was made to know the impact of antenatal steroids on extubation success and also on duration of mechanical ventilation. Various prenatal factors related to mothers will have an effect on neonatal outcome. This include maternal diseases like hypertension, diabetes and also prenatal steroids. The maternal diseases have a poor outcome and prenatal steroids have good outcome and improvement in survival.[35-36] However our study did not show any significant difference among those who received antenatal steroids and who didn't in the two extubation success and failure groups (Table 1).

Various factors which can influence the duration of mechanical ventilation like birth weight, gestational age, presence of maternal comorbidities like hypertension/diabetes, medications like antenatal and postnatal steroids, surfactant and also comorbidities in neonates like sepsis, necrotizing enterocolitis (NEC) and seizures should be considered.

However in our study there was no significant difference in duration of mechanical ventilation was noted for other factors like gestational age, antenatal and postnatal steroids, maternal diseases (Table 3). This study prompts requirement of more such studies with more cases and also inclusion of other hospital setup, referral hospitals and tertiary centres. To provide additional data about various adverse effects. This study also emphasises the fact that efforts are required to reduce the duration of mechanical ventilation and also on follow up of these cases to diagnose the complication and render treatment at the earliest.

CONCLUSION

In this study, we were able to know the common complications involved in prolonged mechanical ventilation. This provides us to think about needs for measures to reduce the duration of mechanical ventilation and thereby reducing morbidities associated with it.

Further studies in this regard is required as antenatal steroids therapy exercises an influence on practically all the organs and systems of the fetus and avoids or eases the complications most commonly associated with prematurity.

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