

STUDY TO ASSESS THE IMMEDIATE OUTCOME OF SURFACTANT THERAPY IN PRETERM NEONATES WITH RDS

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Received Date: 26/12/2023

Acceptance Date: 29/01/2024

Abstract

Background: Surfactant therapy now a days become the primary modality of treatment in Preterm neonates with respiratory distress mainly Respiratory Distress Syndrome(RDS). In Extremely low birth weight babies such as birth weight < 1000g, incidence of RDS as a significant cause of mortality and morbidity remains high. Present study was aimed to assess the immediate outcome of surfactant therapy in preterm neonates with RDS. **Material and Methods:** Present study was a single-center, prospective, observational study, conducted in preterm neonates less than 34 weeks gestation (estimated from mother's 1st trimester ultrasound report or based on Ballard's score if ultrasound report not available) diagnosed with RDS, required mechanical ventilation were treated with surfactant therapy. **Results:** In our study we included a total of 122 preterm neonates, 94 were males and 28 were females. Common clinical features were tachypnea (99.2%), chest indrawing (99.2%), grunting (97.5 %), apnea (37.7 %) & cyanosis (35.2 %). Mean respiratory rate before surfactant therapy was 82.9 ± 5.5 , but it was drastically improved after surfactant administration which was 50.6 ± 10.3 . Same pattern observed with SPO₂ which showed 83.5 ± 2.6 before and after was 94.4 ± 2.1 and heart rate was 146.8 ± 8.7 before and after was 126.7 ± 8.3 . Mean Silverman Anderson Score (SAS) in case of preterm neonate was 6.7 ± 0.7 before and 2 ± 1.2 after surfactant therapy. In our study of 122 neonates in which surfactant has been administered 78 were discharged (63.9 %) while 34.4 % (42) were expired. 2 patients were LAMA. **Conclusion:** Surfactant therapy significantly improved survival in Respiratory Distress Syndrome (RDS) as indicated by significant improvement in vital parameters as well as Silverman Anderson Score.

Keywords: Surfactant therapy. Respiratory Distress Syndrome (RDS), Silverman Anderson Score, preterm neonates

Introduction

Surfactant therapy now a days become the primary modality of treatment in Preterm neonates with respiratory distress mainly Respiratory Distress Syndrome(RDS). In Extremely low birth weight babies such as birth weight < 1000g incidence of RDS as a significant cause of mortality and morbidity remains high.^{1,2}

Respiratory distress syndrome occurs in approximately 50% of preterm infants born at <30 weeks gestation, but only in about 25% of those born >30 weeks. Exogenous surfactant therapy has been shown to be beneficial in 70% of preterm or term neonates with RDS.¹ Surfactant therapy reduces the duration of mechanical ventilation as well as oxygen therapy and thereby reducing the incidence of retinopathy of prematurity.^{1,2}

RDS manifests with respiratory distress, intercostal muscle retraction and cyanosis immediately or a few hours after birth. There after baby's respiratory distress is assessed with chest xray and scoring of respiratory distress severity. A combination of clinical signs of the disease, gestational age, chest xray findings including "ground glass appearance" and "air bronchogram " as well as ruling out other causes of respiratory distress helps in the diagnosis of RDS.³

Surfactant administration as early as within 2 hours of birth is found be effective compared to those administered in well established RDS. Early surfactant therapy has reduced the mortality rates and incidence of BPD and Pneumothorax.⁴ Present study was aimed to assess the immediate outcome of surfactant therapy in preterm neonates with RDS

Material And Methods

Present study was a single-center, prospective, observational study, conducted in Neonatal Intensive Care Unit (NICU) attached to JLN Medical College Ajmer, Rajasthan and NICU, Rajakiya Mahila Chikitsalaya Ajmer, India. Study duration was from September 2021 – December 2022. Study approval was obtained from institutional ethical committee.

Inclusion criteria

- Preterm neonates less than 34 weeks gestation (estimated from mother's 1st trimester ultrasound report or based on Ballard's score if ultrasound report not available) diagnosed with RDS, parents willing to participate in present study

Exclusion criteria

- APGAR score less than 7 at 1 minute,
- presence of congenital anomalies,
- signs and symptoms of chorioamnionitis in mother,
- premature rupture of membrane > 12 hrs

After obtaining ethical committee approval, informed consent was obtained from the parents of the study subjects. Clinical data regarding maternal and neonatal history were recorded including time of onset of symptoms and time of surfactant administration. All the neonates were examined by thorough history taking which included antenatal, natal and postnatal history as well as general physical examination including APGAR score and vitals and systemic examinations. Special emphasis was given on respiratory system examination which include Silverman Anderson Score.

Preterm Neonates presenting with features of Respiratory distress syndrome who required mechanical ventilation were treated with surfactant therapy. A single bolus dose of Curosurf (natural surfactant) 200mg per kg was administered.

Following surfactant administration, neonates were monitored based on Silverman Anderson Score with regard to need for oxygen, need for CPAP ventilation and need for mechanical ventilation. Routine investigations like CBC, CRP, Chest xray were done at the time of admission and vitals were also recorded which include heart rate, respiratory rate, saturation, and Fio₂.

Neonates were put on appropriate device depending on the Silverman Anderson Score like bubble CPAP or Mechanical ventilator and appropriate nursing care was provided under the servo controlled radiant warmer. If the neonate was not improving on Bubble CPAP within 30 minutes, they were immediately taken on Mechanical ventilator and surfactant was administered. If infant was on ventilator directly then surfactant administered as soon as possible. Routine ET suctioning was avoided for first 6 hours after surfactant administration. A repeat chest xray was done after surfactant administration to find out the effectiveness of surfactant. Once the neonate became stable at a CPAP distending pressure of 5cm with Fio₂ < 30% for 6 to 8 hours, CPAP was discontinued and the baby was given oxygen through hood.

The neonate was assessed at the end of 6 hours and 72 hours with regard to improvement in clinical status, need for mechanical ventilation and mortality.

The overall outcome at the end of hospital stay was also assessed. Secondary outcomes like maternal risk factors associated with prematurity and RDS, MAS, incidence of complications like sepsis, apnea, shock, pulmonary hemorrhage, bronchopulmonary dysplasia, PPHN were recorded. The risk factors associated with prognosis in the study population were compared and analyzed. The condition at discharge from the hospital was considered to be normal when there was no neurological disorder (on clinical examination), no pulmonary problems (need of oxygen and/or diuretics), no cardiac disorder, no feeding problems (tube feeding or regurgitation) and no visual, hearing or psychosocial difficulties. The Medical Ethics Committee approved the study and informed consent of the parents were obtained.

The infants who were discharged from the NICU were followed up every 3 monthly up to 1 year of corrected age. On each follow up visit history taking including previous hospitalization and OPD treatment taken for respiratory infections were done. Parents were asked if their children suffered from pulmonary problems.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Statistical analysis was done using descriptive statistics.

Results

In our study we included a total of 122 patients who fulfilled the eligibility criteria. Mean age at admission was 2.4 ± 1.9 hour, Surfactant was administered at a mean age of 4 ± 2.4 hour after birth, mean GA was 31.8 ± 1.9 weeks while mean birth weight in preterm neonates were 1235 ± 236.4 grams. Among the preterm, 94 were males and 28 were females.

In our study, 85.2 % of the preterm were born by vaginal delivery whereas 14.8% by LSCS.

Table 1: General characteristics

Characteristics	No. of patients/ mean \pm SD	Percentage
Age at Admission (Hour)	2.4 \pm 1.9	
Gestation (weeks)	31.8 \pm 1.9	
Age of Surfactant Administration (Hrs)	4 \pm 2.4	
Birth weight	1235 \pm 236.4	
Gender		
Male	94	77.04
Female	28	22.96
Mode of delivery		
NVD	104	85.2
LSCS	18	14.8

Among the maternal risk factor Anemia was most common (55.7 %), followed by Oligohydramnios (11.5 %), Pregnancy Induced Hypertension (PIH) (9 %) & Antepartum Hemorrhage (APH) (9 %). Those without risk factor includes 14% in mothers who have given birth to preterms.

Table 2: Maternal risk factor

Maternal risk factor	No. of patients	Percentage
Anaemia	68	55.7
Oligohydramnios	14	11.5
PIH	11	9
APH	11	9
No risk factors	18	14

Among these neonates in the study, common clinical features were tachypnea (99.2%), Chest indrawing (99.2%), grunting (97.5 %), apnea (37.7 %) & cyanosis (35.2 %).

Table 3: Clinical features

	No. of patients	Percentage
Tachypnea	121	99.2
Chest indrawing	121	99.2
Grunting	119	97.5
Apnea	46	37.7
Cyanosis	43	35.2

In our study among the neonates, Mean respiratory rate before surfactant therapy was 82.9 ± 5.5 , but it was drastically improved after surfactant administration which was 50.6 ± 10.3 . Same pattern observed with SPO₂ which showed 83.5 ± 2.6 before and after was 94.4 ± 2.1 and heart rate was 146.8 ± 8.7 before and after was 126.7 ± 8.3 .

Table 4: Vital parameters before and after surfactant administration.

Vital parameters	Before (Mean \pm SD)	After (Mean \pm SD)
Respiratory rate(RR)	82.9 \pm 5.5	50.6 \pm 10.3
Spo2	83.5 \pm 2.6	94.4 \pm 2.1
Heart rate	146.8 \pm 8.7	126.7 \pm 8.3

Mean Silverman Anderson Score (SAS) in case of preterm neonate was 6.7 \pm 0.7 before and 2 \pm 1.2 after surfactant therapy. Among preterm neonates with RDS in whom surfactant were used with a mean duration of 38.9 hours of MV and 54.4 \pm 47.1 hours of CPAP.

Table 5: Characteristics

Characteristics	Mean \pm SD
Silverman Anderson Score	
Before	6.7 \pm 0.7
After	2.0 \pm 1.2
Ventilation	
Duration of Mechanical Ventilation (MV) (hrs)	38.9 \pm 38.9
Duration of CPAP (hrs)	54.4 \pm 47.1

Among the total neonates in the study who had given surfactant, 38(31.1%) were found to be CRP reactive and remaining 84(68.9%) were found non-reactive.

Table 6: CRP

CRP	No. of patients/ mean \pm SD	Percentage
Reactive	38	31.1
Non reactive	84	68.9

In our study among the 122 preterm neonates, 59% had complications. Among preterm neonates with RDS in whom surfactant has been used almost 31% presented with sepsis & 13.9% of the preterm neonates presented with pulmonary hemorrhage & apnea.

Table 7: Complications

Complications	No. of patients	Percentage
Sepsis	38	31.1
Pulmonary hemorrhage	17	13.9
Apnea	17	13.9

In our study of 122 neonates in which surfactant has been administered 78 were discharged (63.9 %) while 34.4 % (42) were expired. 2 patients were LAMA.

Table 8: Outcome of surfactant therapy:

Outcome	Frequency	Percent
Successfully discharged	78	63.9
LAMA	2	1.6
Expired	42	34.4
Total	122	100

Discussion

Respiratory distress in newborn is recognized as one or more signs of increased work of breathing such as tachypnea, nasal flaring, chest retractions or grunting. Tachypnea is the main presenting symptom of pulmonary disease in neonates. Neonatal lungs are predisposed to pulmonary atelectasis and reduced FRC because of pliable nature of chest wall which is made up of cartilage.

Prematurity is the main risk factor of RDS as surfactant is produced in inadequate amounts until 34 to 36 weeks of gestation. Multifetal pregnancies, maternal diabetes and white male are the other risk factors. Risk decreases with fetal growth restriction, preeclampsia or eclampsia, maternal hypertension, prolonged rupture of membranes, and maternal corticosteroid use. Rare cases are hereditary, caused by mutations in surfactant protein (SP-B and SP-C) and ATP-binding cassette transporter A3 (ABCA3) genes.⁵

Among the preterm, 94 were males and 28 were females. Mean gestational was 31.8 weeks. In a study conducted by Karadang *et al.*,⁶ 122 preterm neonates with RDS were included in which 51% were male with a mean GA of 28.5 ± 1.81 and birthweight was 1143 ± 220 grams. In a study reported by X kong *et al.*,⁷ 81% were male with majority of them with a GA < 28 weeks with birth weight mean 1489.8 ± 350.9 grams. This is in agreement with our study which has male newborn predominance. In our study 46% of the mothers had anemia as a risk factor and 11% had PIH and 12% had APH. This shows anemia is the most common risk factor in mothers who had preterm newborns.⁸

In our study 20.7% were delivered by LSCS while 79.3% were delivered by vaginal delivery (Table 6,7). While in a study conducted by Abhinav *et al.*,⁹ 25% were delivered by vaginal delivery and 75% by LSCS. Apnea was prevalent in 46% of the preterm in our study while it was 25% in a study conducted by Abhinav *et al.*⁹ In our study tachypnea was prevalent in 99.2% of the preterm while in a study conducted by Abhinav *et al.*,⁹ tachypnea was present in all preterms of the study which was in agreement with our study. In a study conducted by Abhinav *et al.*,⁹ grunting was present in 83.3%, cyanosis was present in 75%, chest indrawing in 66.7% of the preterm. While in our study grunting was seen in 97.5%, cyanosis in 35.2% and chest indrawing in 99.2% of the preterms.

In our study mean SAS before surfactant administration was 6.7 ± 0.7 and after was 2 ± 1.2 , while in a study conducted by Nanditha et al³ Downe's score was 8.57 ± 1.04 before surfactant therapy.

Duration of MV was 38.9 hours (1.6 days) and duration of CPAP was 54.4 ± 47.1 hours (2.2 days) in preterm neonates. This is in agreement with M Nakshab *et al.*,¹⁰ who showed a mean duration of MV of 1.4 ± 2.7 days and duration of CPAP of 3.2 ± 1.1 days. This shows the early extubation from ventilator and less CPAP requirement after surfactant

therapy in our study which shows no statistical difference from the above study.

In our study sPO₂ before surfactant administration was 83.5 ± 2.6 and after surfactant administration was 94.4 ± 2.1 and Fio₂ before was 54 and after was 42 which showed significant improvement in vital parameter after surfactant therapy. This was in agreement with a study conducted by Karadang *et al.*,⁶ which elucidates sPO₂ before was 86.9 ± 4.3 and after was 91.1 ± 3.1 . In our study RR before surfactant administration was 82.9 ± 5.5 and after was 50.6 ± 10.3 which showed significant improvement after surfactant therapy. In a study conducted by Abhinav *et al.*,⁹ mean RR before was 72 ± 11.2 and after was 64.3 ± 7.2 which was in agreement with our study. In our study among preterm neonates with RDS, 78(63.9%) were successfully discharged while 42(34.4%) were expired and two of them were LAMA.

Surfactant therapy can be given by INSURE method (intubation, surfactant administration, rapid extubation to NCPAP) which has emerged for RDS treatment. In this method, intubation along with surfactant administration is performed followed by extubation within 1 hour.¹¹ However INSURE method may be more invasive method than CPAP alone, and its failure could lead to worsening of the patient's general condition and is not always successful.¹²

Conclusion

Surfactant therapy significantly improved survival in Respiratory Distress Syndrome (RDS) as indicated by significant improvement in vital parameters as well as Silverman Anderson Score. There was significant decrease in the mean duration of ventilation days, mean duration of days requiring supplemental oxygen therapy after extubation indicating significance of surfactant in decreasing the cost burden as well as complications related to prolonged ventilation.

Conflict of Interest: None to declare

Source of funding: Nil

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