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Early Rescue Therapy for Respiratory Distress Syndrome with a Single Surfactant Dose in a Tertiary Care Teaching Hospital

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Abstract

Background: The neonatal respiratory distress syndrome (RDS) is principally caused by a qualitative and quantitative surfactant deficiency at birth. **Subjects and Methods:** 576 individuals were admitted to the NICU, according to the findings. Respiratory distress syndrome emerged in 87 (15.1%) of the patients. Surfactant therapy was administered to 38 (43.7 percent) of the 87 patients. Males outnumbered females by a ratio of 3.2:1. **Result:** The average age of surfactant administration was 1.5±0.6 hours, and the average Apgar score at 1 and 5 minutes was 4.7±2.4 and 7.1±1.3, respectively. Only 18.4 percent of moms received an antenatal steroid. In 32 weeks cases, the mean gestational age (weeks) and birth weight (gms) were 30.4 weeks and 1272 gm, respectively, but in 32 weeks cases, the mean gestational age (weeks) and birth weight (gms) were 34.6 weeks and 2041gm, respectively (Table 1). In all 38 cases, surfactant was provided as a single-dose rescue therapy. Overall mortality was 42.1 percent, and gestational age was inversely associated to mortality. The survivor group had a considerably lower Fio2 demand after 24 hours. In the survivor group, the mean duration of ventilation was 106.2±27.8.4 minutes, and 23.7 percent of the mothers took prenatal steroid. The most common consequence that resulted in death was sepsis. **Conclusion:** Surfactant administration was associated with decreased ventilatory requirements, improved respiratory status, and early extubation.

Key Words: RDS, Early rescue, Surfactant, Fraction of inspired oxygen & Ventilatory parameters.

INTRODUCTION

Respiratory distress syndrome (RDS) is the most common cause of respiratory insufficiency in preterm newborns, as well as death and morbidity. The risk of RDS rises as the gestational age decreases. RDS affects 60% of infants born at 28 weeks of pregnancy, 30% of infants born between 28 and 34 weeks of pregnancy, and less than 5% of infants born beyond 34 weeks of pregnancy.[1] Kurt von Neergaard, a German-born scientist working in Switzerland in the late 1920s, discovered the role of pulmonary surfactant in promoting lung compliance by lowering surface tension.[2] While working with nerve gases in England in the 1950s, Richard Pattle hypothesised that "lack of the lining substance may sometimes be one of the obstacles with which a preterm newborn has to contend".[3] Around the same time, John Clements, working at the US Army Chemical Center in Edgewood, Maryland, came to a similar conclusion using a modified Wilhelmy balance.[4] Mary Ellen Avery and Jere Mead published a crucial article in 1959 establishing that RDS was caused by a lack of surfactant.[5,6] Prematurely born children with RDS have a developmental shortage of a surface tension-reducing chemical known as surfactant, in which all components that directly contribute to lowering surface tension are decreased or absent.[7] A qualitative and quantitative surfactant shortage at birth is the primary cause of neonatal respiratory distress syndrome (RDS).[8] Enhornig G et al conducted the first experimental investigation establishing the positive effect of surfactant replacement in the early 1970s by instilling a natural surfactant derived from adult rabbit lungs into the trachea of premature rabbits. Several trials and meta-analyses have since decisively demonstrated the effectiveness of this medication in reducing newborn death and morbidity.[9,10] Hyaline membrane disease affected 1.2 percent of all live births and 13.5 percent of all neonatal deaths, according to the national neonatal perinatal database from 2002 to 2003.[11] Despite the fact that surfactant therapy is on the WHO's essential medicine list, a huge section of our population is unable to access it.[12] The patient's lack of affordability and non-availability during emergency hours were the two key deterrents to optimal use. Prophylactic and early rescue approaches to surfactant instillation are two different techniques. The advantage of a prophylactic strategy is that it delivers surfactant to alveoli before mechanical breathing begins, allowing for greater dispersion while the liquid absorption process in the lung is still underway. Early rescue therapy provides the advantage of instilling surfactant in a stabilised newborn and confirming the location of the endotracheal tube.[13] The goal of this study was to evaluate and share our experiences with using early rescue surfactants in newborn infants with RDS.

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METHODS

From September, 2014 to August, 2016, this cross sectional study was conducted in the Department of Neonatal Intensive Care Unit (NICU) of Career Institute of Medical Sciences & Hospital in Lucknow, Uttar Pradesh. For newborns diagnosed with RDS by Chest X-ray and who met one of the following criteria, we used early rescue surfactant therapy (within 2 hours after birth). a) Failure to maintain SpO2 over 87 percent; or Pao2 50 mm Hg with increased FiO2 requirements on bubble CPAP of 7 cm H2O; or b) recurrent apnea necessitating intubation; or c) PaCO2>65 mm Hg; or d) Radiological evidence of Grades III-IV RDS. Infants with structural cyanotic congenital heart disease, severe congenital abnormalities, pulmonary hypoplasia, pneumothorax, or Apgar scores less than 3 at 5 minutes were not included in the study. Exosurf (Burroughs Wellcome Co., USA; dose 5 ml/kg) was given through a side port adaptor over a 5-10-minute period. With the lowest possible peak inspiratory pressures and FiO2, the FiO2 and ventilator settings were modified promptly to maintain appropriate blood gases (PaO2 50-70 mm Hg, PaCO2 40-50 mm Hg, and pH>7.25) with the lowest possible peak inspiratory pressures and FiO2. For the first six hours after surfactant delivery, routine endotracheal tube suctioning was avoided. Blood gases are monitored 30 minutes after the surfactant is applied, and then again if the ventilator parameters alter or if there is a clinical need. SPSS-16 statistical software was used to gather and evaluate all maternal, perinatal, and neonatal data. The Student's t or Mann-Whitney test were used to evaluate continuous variables, and the significance level was set at $p<0.05$.

RESULTS

During the study period, 576 individuals were admitted to the NICU, according to the findings. Respiratory distress syndrome emerged in 87 (15.1%) of the patients. Surfactant therapy was administered to 38 (43.7 percent) of the 87 patients. Males outnumbered females by a ratio of 3.2:1. The average age of surfactant administration was 1.5±0.6 hours, and the average Apgar score at 1 and 5 minutes was 4.7±2.4 and 7.1±1.3, respectively. Only 18.4 percent of moms received an antenatal steroid. In 32 weeks cases, the mean gestational age (weeks) and birth weight (gms) were 30.4 weeks and 1272 gm, respectively, but in 32 weeks cases, the mean gestational age (weeks) and birth weight (gms) were 34.6 weeks and 2041gm, respectively (Table 1). In all 38 cases, surfactant was provided as a single-dose rescue therapy.

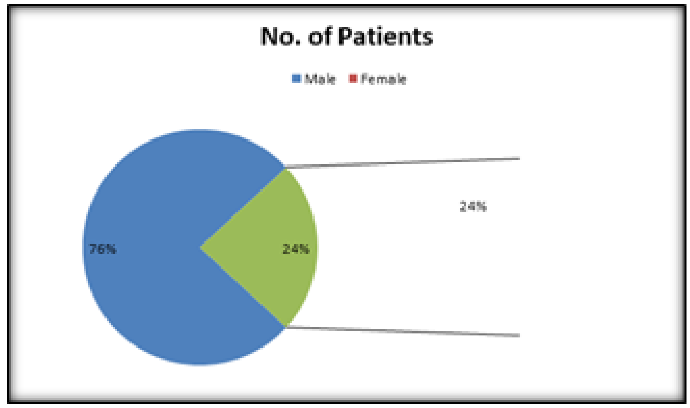

Figure 1: Shows the distribution of gender.

Table 1: shows the features of neonates with respiratory distress syndrome.

Variables		No. of patients (%)
Total admission in NICU		576()
Total cases of RDS		87(15.1%)
Surfactant recipient		38(43.7%)
Sex	Male	29(76.3%)
	Female	09(23.7%)
Mean age of administration of surfactant (hours)		1.5 ± 0.6
Antenatal corticosteroid		07 (18.4%)
	1 pgar	4.7 ± 2.4
	5 pgar	7.1 ± 1.3
Mean gestational age (wks)	≤32weeks	30.4
	≥32weeks	34.6
Mean birth weight(gms)	≤32weeks	1272
	≥32weeks	2041

Table 2: Shows the ventilatory parameters before and after surfactant therapy.

Parameters	Before	After surfactant			P value
		6hr	12hr	24hr	
Frequency(breaths/min)	30.04±10.2	30.02±8.07	29.2±9.05	25.02±7.04	0.04
PIP(cm of H2O)	20.06±6.04	21.2±6.06	21.7±6.41	20.7±5.87	0.34*
PEEP(cm of H2O)	5.2±1.4	5.4±1.6	5.7±1.7	5.02±1.0	0.02
Fio2	0.82±0.15	0.66±0.4	0.56±0.24	0.45±0.6	0.03

Table 3: Shows the ABG parameters before and after surfactant therapy.

ABG parameters	Before surfactant	After surfactant	P value
PH	7.26±2.16	7.34±2.17	0.52*
Pao2	77.24±26.4	107.6±32.34	0.46*
Paco2	46.62±21.6	47.5±22.4	0.54*
Hco3-	9.56±4.04	22.3±10.4	0.26*

Table 4: Shows the outcome of surfactant therapy.

Gestational age	Cases of RDS (n=87)	Surfactant given (n=38)	Survived (n=22)
<28wks	05 (5.7%)	03 (7.9%)	00 (0.0%)
28-30	17 (19.5%)	12 (31.6%)	07 (31.8%)
31-33	25 (28.7%)	13 (34.2%)	09 (40.9%)
≥34	40 (45.97%)	10 (26.3%)	06 (27.3%)

Table 5: shows the features of survivor and non-survivor infants following surfactant therapy.

Characteristics		**Survivor(38)**	**Non –survivor (16)**
Mean birth weight		1121..4±248.06	1461.7±209.2
Mean gestational age		28.6±10.04	30.4±12.5
Mean Duration of ventilation (hour)		106.2 ±27.8	120.6±48.2
Fio2 at	0 hour	0.82±0.00	0.84±0.11
	24 hours	0.31±0.17	0.54±0.16
Antenatal steroid		09(23.7%)	01(6.3%)
Sepsis		03(7.9%)	06(37.5%)

The change in ventilatory rate (breaths/min) before (30.04±10.2) and 24 hours after surfactant therapy (25.02±7.04) was statistically significant (p value.04). At 6, 12, and 24 hours, the fraction of inspired oxygen concentration (FiO2) need falls considerably (p value0.03) before and after therapy. PEEP also exhibits a declining trend after 24 hours (p value 0.02), however this is not statistically significant after 6 and 12 hours [Table 2] Although ABG values improved before and after surfactant therapy, the difference was not statistically significant [Table 3].

Overall mortality was 42.1 percent, and gestational age was inversely associated to mortality. The survivor group had a considerably lower Fio2 demand after 24 hours. In the survivor group, the mean duration of ventilation was 106.2±27.8.4 minutes, and 23.7 percent of the mothers took prenatal steroid. The most common consequence that resulted in death was sepsis. [Figures 4 and 5]

DISCUSSION

Respiratory distress syndrome(RDS) is known to affect 6.8-14.1 percent of preterm live births in the United States.[11,14] The frequency is as high as 32 percent at 29-30 weeks gestational age, whereas the incidence at 28 weeks is unknown.[14] In our country, RDS is the most common sign of ventilation in newborns.[15] It was nearly 15.1 percent in our hospital. The limited coverage of prenatal steroids and the referral of many high-risk moms can explain the high occurrence. Surfactant experiments and clinical experience have shown that prenatal steroids have a synergistic effect in lowering the incidence, severity, and requirement for surfactant, as well as death.[16] Only 18.4 percent of the participants in our research received the full course of recommended prenatal steroids. Due to practical issues like as cost and the lack of a backup ventilator, not all worthy babies could receive SRT. Surfactant is one of the most expensive treatments for RDS in premature newborns. However, in industrialised nations, it has been shown to be the most effective and conventional treatment for RDS in preterm newborns, with considerable reductions in death and morbidity.[17] Surfactant therapy in RDS has been established in randomised clinical studies to result in a 40% reduction in mortality and a 35-50% reduction in air leakage.[18,19] Surfactant therapy significantly improves ventilatory parameters before and after surfactant therapy, with a significant reduction in Fio2 requirement (p value0.03) and ventilatory rate at 24 hours (p value0.05), resulting in a significant reduction in baro trauma in these babies, according to our findings.[17] Surfactant increases lung capacity in under-aerated areas and improves oxygenation through other mechanisms.[20,21] High alveolar ventilation-perfusion ratios (VA/Q) regions can be caused by pulmonary underperfusion. As a result, hypoxemia treatment may diminish high VA/Q regions by preventing vasoconstriction or lowering mean arterial pressure (MAP) (a high MAP would tend to collapse compliant pulmonary vessels). Surfactant, on the other hand, may help to normalise high VA/Q regions by lowering over-ventilated lung regions. Neonatal mortality and bronchopulmonary dysplasia are reduced when rescue surfactant treatment is given within two hours of birth.[22] Sepsis was the most prevalent consequence in ventilated newborns, with a reported incidence of up to 65 percent. Septicemia has been identified as the leading cause of death in ventilated infants.[23] Infection rates are directly proportional to the length of time patients are ventilated and the length of time they are in the hospital. Because our patients were of low socioeconomic position and received poor prenatal care, septicemia was directly responsible for 56.2 percent of total deaths in this study. Our gestational age-specific mortality following surfactant replacement therapy was comparable to earlier Indian data, but it was greater than western reports.[24,25] Patient ratios and congestion are issues we encounter as a result of inexperienced nurses. Overall mortality in surfactant recipient newborns was 25.3 percent, with gestational age being negatively related,[26] which is typical to other research from underdeveloped countries (21-80 percent).[9] Preterm babies (28-33 weeks) and kids born with a low birth weight (less than 1500 grammes) had the greatest impact on survival.[25] Early diagnosis and treatment of RDS are critical to its successful management. Invasive and non-invasive mechanical ventilation, such as nCPAP, are used to treat RDS. Surfactant use necessitates the presence of qualified professionals to regulate newborn ventilation as well as the availability of facilities to provide comprehensive critical care. Although surfactant therapy looks to be expensive at first, it really lowers the entire cost of care by reducing the time of ventilation, NICU hospitalisation, and different morbidities.[27]

CONCLUSION

In conclusion, Surfactant administration was associated with decreased ventilatory requirements, improved respiratory status, and early extubation. The maximum impact on survival was seen in preterm babies (28-33weeks) and very low birth weight (<1500gm). Sepsis is an important complication and its presence; along with a high RDS score at intubation are significant predictors of mortality.

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