MAR Pediatrics (2025) 6:2

Review Article

Surfactant Replacement Therapy- prophylactic versus early rescue in Preterm Neonates: An Institutional Review from a Tertiary Hospital in Kashmir

Dr. Junaid Mehraj[1], Dr. Mukhtar Ahmad[1], Dr Naseer Yousuf Mir*[2], Dr Sheikh Nisar Ahmad[1], Dr Riyaz Malik[3], Dr Asif Ahmad[4,] Dr Nazir Ahmad Parray[4]

1. Senior Resident, Department of Pediatrics, SKIMS Medical College, Bemina, Srinagar.

2. Assistant Professor Pediatrics Government Medical College Handwara.

3. Professor, Department of Pediatrics, SKIMS Medical College, Bemina, Srinagar.

4. Assistant professor pediatrics, SKIMS Medical College, Bemina, Srinagar.

***Correspondence to:** Dr Naseer Yousuf Mir, Assistant Professor Pediatrics Government Medical College Handwara, Jammu and Kashmir, India.

Copyright

Received: 19 July 2025

Published: 04 Aug 2025

Abstract

Background*: Respiratory distress syndrome (RDS), predominantly due to surfactant deficiency, remains a major health concern among premature neonates. Surfactant Replacement Therapy (SRT) has been pivotal in improving neonatal survival and reducing complications.* ***Objective:*** *To assess and compare clinical outcomes of prophylactic versus early rescue surfactant administration in preterm neonates diagnosed with RDS.* ***Methods****: A retrospective study was undertaken over two years at a tertiary-level NICU, evaluating 334 premature neonates. Of these, 46 (13.8%) with Hyaline Membrane Disease (HMD) received surfactant therapy. The neonates were divided into two cohorts: prophylactic (n=8) and early rescue (n=38). Clinical parameters, treatment timing, complications, and outcomes were analyzed.* ***Results:*** *Neonates in the prophylactic group were more premature (mean gestational age: 27.6 weeks) and had lower birth weights (1164g) compared to those in the rescue group (33.1 weeks, 1312g). Surfactant administration occurred earlier in the prophylactic group (mean: 1.2 hours vs 3.2 hours). While the rescue group experienced more complications like shock (73.7%) and required prolonged ventilation, it demonstrated a higher survival rate (89.5% vs 50%).* ***Conclusion:*** *Although prophylactic surfactant was delivered earlier, improved outcomes were seen in the rescue group—likely due to better maturity and baseline health. These findings underscore the need for larger, prospective studies tailored to resource-limited settings to optimize SRT use.*

Keywords: *Surfactant therapy, Prematurity, Respiratory distress syndrome, Prophylactic surfactant, Early rescue therapy, Neonatal outcomes.*

Introduction

Respiratory Distress Syndrome (RDS), primarily caused by surfactant deficiency, is a major cause of neonatal mortality and morbidity, particularly in preterm infants. Surfactant replacement therapy (SRT) represents a cornerstone in the management of RDS. [1] The clinical milestone in surfactant discovery began in the 1950s and gained national attention with the death of Patrick Kennedy in 1963, which catalyzed RDS research. RDS is characterized by atelectasis, impaired gas exchange, and pulmonary edema due to insufficient or dysfunctional surfactant. Risk factors include prematurity, cesarean delivery, maternal diabetes, and male sex

[2,3]. Clinical features include grunting, nasal flaring, retractions, cyanosis, and respiratory failure. Diagnosis is made on clinical grounds and chest radiograph findings. Early administration of surfactant improves outcomes [4]. Surfactants are lipid-protein complexes that reduce surface tension in the alveoli. They may be natural (animal-derived), modified natural, or synthetic. Administration methods include standard intubation, INSURE (Intubate-Surfactant-Extubate), and LISA (Less Invasive Surfactant Administration). Early or prophylactic therapy is recommended for high-risk neonates [5,6].

Materials and Methods

This study was carried out retrospectively at the NICU of SKIMS Medical College Hospital, Bemina, over a two-year period (January 2021–December 2022). From 334 preterm neonates admitted during this time, 46 infants diagnosed with HMD and treated with surfactant were enrolled for review.

Inclusion Criteria:

- Preterm neonates (<37 weeks gestation)
- Clinical and radiological diagnosis of RDS/HMD
- Received exogenous surfactant therapy

Exclusion Criteria:

- Presence of major congenital anomalies
- Perinatal asphyxia or primary diagnosis of neonatal sepsis

Participants were classified as:

- Prophylactic group (n=8): Surfactant administered within 30 minutes of birth based on risk.
- Rescue group (n=38): Surfactant administered following clinical diagnosis within 6 hours post-birth.

Data points included demographics, Apgar scores, surfactant timing, complications (e.g., NEC, pneumothorax, pulmonary hemorrhage, shock), ventilation duration, and survival outcome.

Results

During 2021–2022, 334 preterm neonates were admitted at SKIMS MCH Bemina. Of these, 46 (13%) developed Hyaline Membrane Disease (HMD) requiring surfactant therapy.

- **Mean Age at Admission**: Infants in the prophylactic group were admitted earlier (25 minutes after birth) compared to the rescue group (1.7 hours), indicating more immediate recognition and intervention in the former.

- **Sex Distribution**: The male-to-female ratio was 3:1 in the prophylactic group and 12:7 in the rescue group, reflecting a male predominance in both.
- **Mean Weight and Gestational Age**: The prophylactic group had lower average birth weight (1164 gm) and gestational age (27.6 weeks), indicating that these were more premature and lower birth weight infants. The rescue group was relatively more mature and heavier (1312 gm, 33.1 weeks).
- **Timing of Surfactant Administration**: Surfactant was administered earlier in the prophylactic group (mean of 1.2 hours) than in the rescue group (3.2 hours), as expected based on the treatment strategy.
- **Ventilation Days**: The rescue group required a longer duration of mechanical ventilation (5.8 days) than the prophylactic group (4.7 days), suggesting more severe or prolonged respiratory distress.

- **Complications**:
    - **Pneumothorax** and **Pulmonary Haemorrhage** were more common in the prophylactic group.
    - **Shock** was significantly higher in the rescue group (73.6%) compared to the prophylactic group (50%).
    - **Necrotizing Enterocolitis (NEC)** occurred in both groups but was slightly more frequent in the prophylactic group (50% vs 15.7%)
- **Survival Rate**: The survival rate was significantly higher in the rescue group (89.5%) compared to the prophylactic group (50%). However, this result might be influenced by the smaller sample size and higher severity of prematurity in the prophylactic group.

Table 1: Surfactant Usage at SKIMS MCH Bemina

Surfactant Use	Number of Patients	Percentage
Prophylactic	8	17.4%
Early Rescue	38	82.6%
Total	46	100%

Table 2: Outcomes of Surfactant Therapy

Outcome	Number of Patients	Percentage
Survived	38	82.6%
Died	8	17.4%
Total	46	100%

Table 3: Comparative Characteristics of Prophylactic vs Rescue Surfactant Therapy Groups

Characteristics	Prophylactic Group (n=8)	Rescue Group (n=38)
Mean Age at admission	25 mins	1.7 hrs
Male: Female	3:1	12:7
Mean weight	1164 gm	1312 gm
Mean gestational age	27.6 weeks	33.1 weeks
Mean Age at time of surfactant Rx	1.2 hrs	3.2 hrs
Mean Days on ventilator	4.7	5.8
Pneumothorax	02 (25%)	04 (10.5%)
Pulmonary hemorrhage	02 (25%)	06 (15.7%)
IVH	None	None
Shock	04 (50%)	28 (73.6%)
NEC	04 (50%)	06 (15.7%)
Survival	04 (50%)	34 (89.5%)

Discussion

Our findings reflect that neonates receiving prophylactic surfactant were significantly more premature, which could explain their higher mortality despite earlier intervention. The improved outcomes in the rescue group align with studies suggesting that gestational age and weight are critical determinants of neonatal survival. Although prophylactic therapy enables early stabilization, its benefit may be limited in extremely premature neonates with multiple vulnerabilities.

Higher incidences of shock in the rescue group may relate to delayed disease progression or complications from mechanical ventilation. Nonetheless, this group showed better survival, suggesting that judicious, timely rescue therapy can be equally, if not more, effective in relatively mature infants. Emerging methods like Less Invasive Surfactant Administration (LISA) may offer improved outcomes and merit further exploration in future trials.

Conclusion

Surfactant therapy is a proven intervention for RDS in preterm infants. While prophylactic administration ensures early disease management, survival appears more favorable in neonates treated with rescue therapy, particularly those with higher gestational maturity. Refinement of treatment protocols and multicentric evaluations are crucial to enhancing neonatal care in low-resource environments.

Acknowledgment: Gratitude is extended to NICU staff of SKIMS MCH Bemina for their support and dedication in neonatal care and data collection

Declarations

Conflict of Interest: None declared

Funding: No external funding.

References

1. Sweet DG, et al. European Consensus Guidelines on the Management of Respiratory Distress Syndrome – 2022 Update. Neonatology. 2022;119(1):1–16.

2. Jobe AH, Bancalari E. Bronchopulmonary Dysplasia. Am J Respir Crit Care Med. 2001;163(7):1723–1729.

3. Soll RF, Ozek E. Prophylactic vs Selective Use of Surfactant in Preventing Morbidity and Mortality in Preterm Infants. Cochrane Database Syst Rev. 2009;(1):CD000510.

4. Ramanathan R. Role of Surfactant Therapy in Neonatal Respiratory Distress Syndrome. J Perinatol. 2006;26: S13–S20.

5. Neu J, Walker WA. Necrotizing Enterocolitis. N Engl J Med. 2011;364(3):255–264.

6. Stoll BJ, et al. Neonatal Outcomes of Extremely Preterm Infants from the NICHD Neonatal Research Network. Pediatrics. 2010;126(3):443–456..