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Review Article

# Surfactant Administration through Laryngeal Supra Glottic Airway Technique in Preterm Babies; A New Era Waiting Exploration

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## Abstract

Respiratory distress syndrome (RDS) is common morbidity in pre term babies. Treatment involves antenatal corticosteroids, respiratory support and exogenous surfactant therapy. Surfactant therapy has undergone evolution over time. Supra-glottic air way devices (SAD) like laryngeal mask air way (LMA) is emerging a safer and better option. This review article aims to review supra glottic air way devices like LMA use to provide eminent therapy to pre term babies.

***Keywords:*** *Respiratory Distress Syndrome (RDS); Less Invasive Surfactant Administration (LISA); Minimal Invasive Surfactant Administration (MISA); Surfactant Administration Through Laryngeal Supra Glottic Air Way (SALSA); Supra Glottic Airway Devices (SAD); Silverman-Anderson Score (SAS)*

## Introduction

Respiratory distress syndrome is the major cause of morbidity and mortality in preterm babies, inversely related to gestational age. RDS presents most commonly immediately after birth in preterm babies and less commonly in term babies. Different treatment modalities have been introduced over decades for treatment of RDS along with respiratory support like antenatal steroids, surfactant administration and advanced respiratory care [1]. Respiratory distress syndrome occur due to inadequate production or lack of enough time to get maturation as in the case of late pre terms and pre terms [2] Surfactant is the definite treatment of RDS in which respiratory support from CPAP is inadequate. Surfactant administration is evolving technique, devices like endotracheal tube, thin catheter and supra glottic airway devices have been used to administer surfactant. Supra glottis airway devices for surfactant administration are fascinating, providing encouraging data to administer surfactant through supra glottis devices successfully with less need to intubate [3].

### Anatomy, embryology and pathogenesis

Fetal lung development is a step wise process, involving 5 stages of development embryonic, pseudo glandular, canalicular, saccular and alveolar stages [4]. Ventral protrusion of esophagus appears as lung bud in embryonic period at 26$^{th}$ day of embryo [5]. By 37 days of embryo major development happens when the lung bud divides in mesenchyme after forming main stem and development of pulmonary vasculature. At 5$^{th}$ week pseudo glandular stage starts during which pulmonary stem branches. Canalicular stage starts at 16$^{th}$ week,

marked by formation of acnes, blood-air barrier and surfactant formation. With time capillary size and number increases with vascularization. Formation of bronchioles thins mesenchymal membranes, capillary and respiratory membranes fuse, forming Bloor-air barrier. Saccular stage starts at 24$^{th}$ weeks marked by formation of terminal saccules developing into respiratory bronchioles [6]. At 32 weeks start alveolar stage marked by formation of septage in respiratory bronchioles increasing surface area for gas exchange.

### Epidemiology

15% of terms and 29% of the late pre terms develop respiratory morbidity leading to admission in NICU, this is even more in pre term babies [7]. Numerous risk factor have been identified contributing to RDS, these include prematurity, maternal diabetes, perinatal asphyxia, male gender and white race [8].

### Clinical presentation

Clinical signs vary from mild nasal flaring to tachypnea, cyanosis, substernal and intercostal recessions, grunting to respiratory failure [9]. Silverman-Anderson retraction score is used to assess the severity of respiratory distress in preterm babies without respiratory support [10]. This score comprises four inspiratory categories of movements (thoraco- abdominal, intercostal, xiphoid, and chin movement), and 1 expiratory movement grunting. SAS is a valuable tool for predicting need for respiratory support.

### Diagnosis

RDS is diagnosed on clinical presentation and x-ray chest featuring homogenous lung disease with atelectasis classically presenting as ground-glass reticulo-granular appearance with air Broncho gram, and supportive investigation [11].

### Treatment

Treatment of RDS stars with antenatal corticosteroids [12], non-invasive respiratory support like high flow nasal cannula (HFNC), continuous positive airway pressure (CPAP), nasal intermittent positive pressure ventilation through nose (NIPPV), are the initial ways to manage respiratory Distress syndrome in preterm infants. These respiratory supports are found to decrease need for invasive ventilation by 50% in infants [13,14]. Sometimes noninvasive respiratory support is insufficient increasing the need for surfactant administration and mechanical ventilation, which can increase incidence of bronchopulmonary dysplasia, and death [15]. Use of early respiratory support along with surfactant administration can change the outcomes for pre term babies. Surfactant can be administered with various techniques like intubate, give surfactant and extubate (INSURE), during NCPAP, less invasive surfactant administration (LISA), minimal invasive surfactant administration (MISA), aerosolized surfactant administration have been found effective in treatment of respiratory distress syndrome of newborn [16]. According to European Consensus guidelines surfactant is given to pre term babies when Fio2 requirement increases more than 30%, and in term babies more than 40% and x-ray chest is suggestive of RDS. It has been found that there is no difference in outcome if equal dose of different surfactant is used to treat RDS [17].

## Discussion

Surfactant administration technique has been evolved over time. It started with simple technique of instilling surfactant in pharynx with thin tube, endotracheal intubation and surfactant administration, LISA, MISA, aerosolized surfactant and surfactant administration through laryngeal supra glottic airway technique (SALSA) [18-22]. Surfactant administration through laryngeal supra-glottic airway devices (SAD) is a fascinating and unique technique in pre term babies, attracting physicians as endotracheal intubation in pre term babies requires expertise and experience. There is more chance of injury and technical failure due to smaller airway. Also endotracheal intubation is associated with hypoxia, bradycardia, fluctuation in blood pressure, increasing chance of other morbidities [23].

The classic LMA is made of medical grade silicone, it has oval shaped mask with inflatable outer rim, an airway tube, originating from back plate, joined at the proximal end with 15 mm connector. The Pro Seal LMA had modified features of better seal with peri-glottic tissue. I - gel is disposable SAD is made from medical grade thermoplastic elastomer gel requiring no inflation. Smallest available LMA size available is 1 which have been used in infants 29- 34 weeks of gestation and weight more than 1 kg (Figure 1).

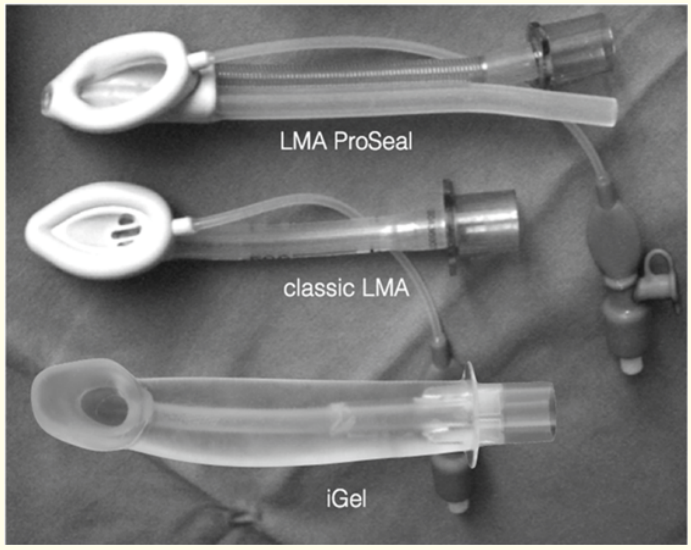


***Figure 1***

Several studies have used classic LMA and a few used Pro Seal and I gel LMA. Joshua T. Attridge., *et al.* conducted a pilot study using LMA for rescue surfactant administration in pre term babies weighing more than 1.2 kg and showed significant decrease in oxygen requirement but limitation of study was less number of patients and inability to describe out comes in babies [24]. A study done by Pinheiro J M compared the delivery of surfactant through LMA and endotracheal intubation. The proportion of surfactant therapy failure was higher in endotracheal tube group 77% compared to 30% in LMA. Early failure including mechanical ventilation was more in ETT group. Other failures were not significant in both groups of study. Limitation of the study was that it was limited to pre term babies more than 29 weeks and weight up to 1000 grams [21]. Roberts, Calum T., *et al.* reviewed 5 published studies on supra glottic air way devices for surfactant administration. They concluded the safety and easier technique with LMA, less failure rates however they emphasized further studies to be conducted to establish the evidence for LMA use for surfactant administration [3].

Monika Kaushal., *et al.* reported a case of successful surfactant administration in a case of Beckwith-Wiedmann syndrome with SALSA technique and baby responded very well with no complications noted [25]. A systemic review and meta-analysis reported effectiveness of SALSA technique, six randomized control trials were included. Surfactant administration with LMA was associated with decreased FIO2 requirement (mean difference = 1.82 (95% confidence interval CI:6.01 to 9.66), decreased intubation (risk ratio = 0.17;95% CI:0.05 - 0.57) and decreased mechanical ventilation (RR = 0.44;95% CI:0.31 - 0.61), there was no difference in the groups for death, Bronchopulmonary dysplasia, or pneumothorax [26].

## Conclusion

Surfactant administration with LMA through SALSA technique is unique fascinating and attractive to physicians as LMA is easy to insert and requires less expertise than endotracheal intubation. Chances of technical failure and air way injury is less. Multiple studies and meta-analysis have revealed the effectiveness of SALSA technique with LMA. Most of the studies have involved pre term babies not less than 29 weeks and weight not less 1000 grams. However data about pre term babies less than 29 weeks and weight less than 1000 grams is not available. Primary outcomes in the form of oxygen requirement better physiological state and less need for endotracheal intubation are significant, however outcomes like BPD, death and need for further doses comparable to classic techniques of surfactant administrations are not established. Despite of effectiveness of LMA in the treatment of RDS, there is no evidence of use of SAD in extreme pre term babies. Extensive randomized control trials with large number of patients are needed to fetch evidence. Further studies are required to explore the size of LMA, type of LMA used and to determine the pulmonary outcomes in babies. SAD can be the breakthrough in journey of RDS treatment. This fascinating and unique era needs more exploration to get recognized.

## Conflicts of Interest

There is no financial or non-financial interest with any organization in this manuscript.

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## Authors Contribution

Concept, idea, processing and critical analysis and literature review.

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