



## Direct Tracheobronchial Suction: A Simple Technique to Relieve Post-Extubation Atelectasis in an Extremely Low Birth Weight Infant

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### Abstract

Post-extubation atelectasis is a common pulmonary complication of critical neonates who have received long-term, high-setting of mechanical ventilator, resulting in re-intubation, increased morbidity and lengthened hospitalizations. A rapid and effective management to open the lungs is important to prevent reintubation. We reported an extremely preterm infant with massive post-extubated atelectasis of bilateral lungs, and he was successfully treated by using the simple technique of direct tracheobronchial suction (DTBS) to quickly open his lungs.

A 7-day-old preterm infant with a birth weight of 732 g got massive atelectatic lungs at 24 hours after extubation. DTBS was performed by directly inserting a 6.0 Fr. suction tube into his trachea via the assist of laryngoscope. The infant's head was turned to one side while passing the suction tube into the bronchus of the opposite side. This suction procedure was repeated until nothing could be suctioned out, and DTBS was repeated every 8 hours in the following 24 hours after extubation. Nasal prong continuous positive airway pressure was kept, and the heart rates and oxygen saturation were continuously monitored during DTBS. Sticky secretions were observed at the laryngeal site and suctioned out from the tracheobronchial airways. The follow-up chest x-ray film revealed opened lungs 24 hours later. Therefore, DTBS is effective and safe to relief obstructed airways and reopen the lungs of the reported extremely premature infant.

**Keywords:** Post-extubation atelectasis; Direct tracheobronchial suction

### Introduction

Post-extubation atelectasis is a common pulmonary disorder that lengthens the hospitalization time of neonates in intensive care units who have received long-term, high-setting of mechanical ventilator, resulting in increased morbidity among these infants. The incidence of post-extubation atelectasis has been reported in 16.7 to 50% of intubated neonates, especially in those premature infants group [1,2].

The current conventional prevention strategies and management of post-extubation atelectasis including mucolytic medication, chest physiotherapy, but poor response and re-intubation rate in neonates, especially in premature infants are still high which has been reported ranged from 18 to 34% [1-7]. Some reports have been documented and suggested the use of bronchoscope to check and relieve that intractable atelectasis. However, technical limitation and instrument limitation of bronchoscope may made difficulties in many institutes to perform those invasive techniques, especially performed in neonates or premature infants [6]. A simple technique of direct tracheobronchial suction (DTBS) had been reported for relieving post-extubated atelectatic lungs in premature infants [6].

DTBS could achieve direct clearance of trachea and bronchus by multiple insertions, natural curvature of suction tube tip and head positioning without the need of re-intubation. The effective airway secretion removal could predict good results of resolving the massive atelectasis and preventing the possibility of re-intubation. There are some immediate findings such as respiratory distress improved with increased audible air entry on the affected lung; decreased chest retractions; significant fall in respiratory rate and heart rate; arterial blood gases analysis showed

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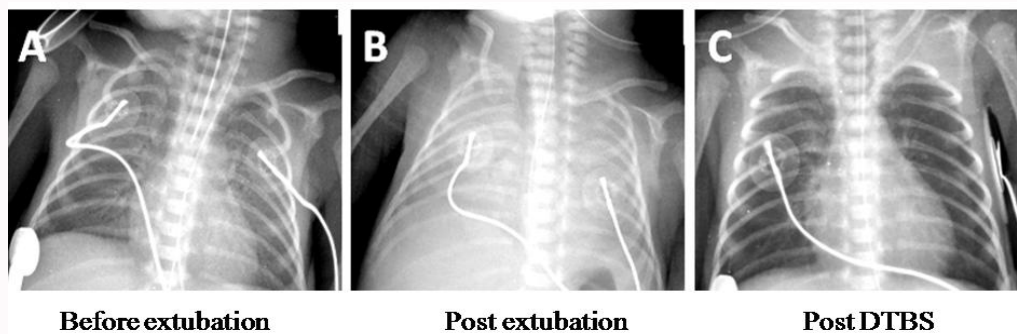
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**Figure 1:** Chest plain film of the presented premature infant. (A) Before extubation. (B) 24 hours after extubation. Massive pulmonary atelectasis at bilateral lung fields was shown. (C) 24 hours after performing direct tracheobronchial suction. It showed well-expanded lungs bilaterally.

significant improvement of pH, partial pressure of carbon dioxide and oxygenation ratio and partial or nearly complete resolution of the atelectasis by chest radiograph check-up. Besides, the aspirated secretion in suction tube could also send for laboratory study if needed [6].

Here, we present an extremely preterm infant who suffered from massive lung atelectasis after extubation and got significant improvement 24 hours after being performed with DTBS.

### Case Presentation

The case is a male infant delivered at gestational age of 28 weeks by cesarean section from a 33-year-old woman due to severe preeclampsia. His birth weight was 732 gm, and the Apgar scores were 3, 6 and 8 at 1, 5, and 10 min after delivery. After birth, he got severe respiratory distress with subcostal retraction and cyanosis, so oral endotracheal tube was inserted and he was ventilated with high-frequency oscillatory ventilation. The chest x-ray film revealed grade III respiratory distress syndrome (RDS) (Figure 1A). The pulmonary conditions got improved gradually, and the chest x-ray film showed a good improvement. Extubation was done on the 7<sup>th</sup> day of life. Nasal prong continuous positive airway pressure (NCPAP) was applied immediately after extubation. Noninvasive positive pressure ventilation (NIPPV) (rate = 20 breaths/min, peak inspiratory pressure = 18 cmH<sub>2</sub>O, positive end expiratory pressure = 6 cm H<sub>2</sub>O, and FiO<sub>2</sub> = 0.3) were applied. Under these settings, there was no significant hypercapnia or hypoxia observed during the first 12 hours after extubation. However, relative fluctuation and occasional dropping of the oxygen saturation to lower than 90% started to be observed at night. The FiO<sub>2</sub> needed to be increased to 0.4 for maintaining oxygen saturation higher than 90%. Mild tachypnea and subcostal retraction of the infant were also observed. The blood gas also showed compensatory respiratory acidosis with a tendency of increasing PaCO<sub>2</sub>. Chest x-ray film was rechecked at approximately 24 hours after extubation, and it showed white-out appearance with decreased lung volume at bilateral lung fields. Massive post-extubation atelectasis was considered (Figure 1B).

By the use of a laryngoscope, the oral cavity and larynx were checked firstly. Much sticky secretion was observed and removed by using cotton swabs (Figure 2). Then, DTBS was performed under the continuous support of NCPAP. Three minutes before the procedure, the FiO<sub>2</sub> was increased 20% higher than before for pre-oxygenation. While performing DTBS, we inserted a 6.0 Fr. suction tube into his trachea directly via the assist of laryngoscope. The infant's head was put on neutral position while inserted the tube into the vocal cord. While reaching the vocal cord, the infant's head was turned



**Figure 2:** Thick and glutinous secretion removed by cotton swabs from the laryngotracheal orifice of the presented premature infant.

to right side firstly and the suction tube was passed deeper into left bronchus until a resistance was felt. Then, the suction tube was slowly withdrawn out with a suction pressure of 80 mmHg. This suction procedure would be repeated again until nothing could be suctioned out. After that, we suctioned the right bronchus with head turned to the left side until the airway is clear. Between each two suction, we kept the mouth closed and waited for the oxygenation turning back to be higher than 95%. During the procedures, transient oxygen desaturation and brief bradycardia were observed occasionally, and they returned back quickly. Topical epinephrine was applied over larynx after whole procedure for laryngeal swelling. The DTBS was performed again in an interval of 8 hours.

The follow-up chest x-ray film revealed opened lungs 24 hours later (Figure 1C). After that, DTBS was performed twice a day for two more days. His respiratory condition got improved and the settings of NIPPV were able to be weaned gradually.

When the patient was 28 days old, the baby still required NCPAP with NIPPV. At postmenstrual age of 36 weeks, he still required the support of high-flow nasal cannula oxygen to maintain a nasal continuous positive airway pressure with 3 cmH<sub>2</sub>O PEEP and oxygen (FiO<sub>2</sub> = 0.25), so he was diagnosed as moderate to severe bronchopulmonary dysplasia (BPD) of prematurity. With a good care, neither NCPAP nor oxygen was required 3 weeks later, and he was discharged at postmenstrual age of 40 weeks with body weight reaching 2100g. The patient was under regular out-patient follow-up with generally well-being.

### Discussion

Atelectasis is known as the loss of lung volume due to the collapse

of lung tissue, and the most type in adult and children is obstructive type. The critical illness neonates, especially premature infant in intensive care unit usually require intubation with mechanical ventilation support and frequent secretion suction [1,2]. There are some researches had documented the recent ventilator strategy with high frequency oscillatory ventilator compared with conventional ventilation in premature infants, and better successful extubation rate had reported with premature infants who use high frequency oscillatory ventilator and the age at successful extubation was also significantly lower compared with those who use conventional ventilator [8-11]. But, there are still many risk factors played important role in atelectasis process causing alveolar collapse, such as neonates are sensitive to the obstructing effects of accumulating airway secretions, most likely because of small airway size and a less effective cough secondary to muscle weakness; endotracheal tubes complicate this problem by impairing mucociliary clearance, inhibiting an effective cough, causing airway mucosa damage and granulation tissue formation; neonates have a decreased number of pores of Kohn which limits collateral ventilation [6,7]. The high incidence of post-extubation atelectasis has been reported in 16.7 to 50% of intubated neonates, especially in those premature infants group, result from above risk factors [1,2].

Due to the above risk factors and the most cause of airway secretions, the goals of prevention and management of post-extubation atelectasis is remove airway secretion as soon as possible to keep patent airway and avoid subsequent pulmonary dysfunction. Traditionally, the treatment strategies for post-extubation atelectasis of intubated neonates were mucolytic medication and intensive chest physiotherapy. However, tiny neonates and premature infants often could not stand for fierce percussion movement, and would sometimes lead to brain damage or bleeding tendency. Generally, if the massive post-extubation atelectasis could not be resolved by chest physiotherapy, re-intubation was necessary for following respiratory support and secretion clearance and got temporary improvement. But, the subsequent trauma processes caused by endotracheal tubes and suction tubes would lead to further more atelectasis episode after extubation and add up to a vicious cycle of pulmonary destruction which affected pulmonary development of fragile neonates and premature infants [6]

Bronchoscopy with or without endotracheal tube is a useful technique to achieve diagnosis and treatment for atelectasis. However, premature infants may not stand for the procedure under general anesthesia, and their airway may too small to receive a standard pediatric bronchoscope. Therefore, direct tracheobronchial suction seen to be the better choice to achieve direct tracheobronchial clearance without the need of re-intubation and the use of bronchoscope. Under the bedside monitors for basic vital sign and saturation, and with a laryngoscope and a suction tube, we could precisely perform direct clearance of trachea and bronchus by multiple insertions, natural curvature of suction tube tip and head positioning. The effective airway secretion removal could predict good results of resolving the massive atelectasis and preventing the possibility of re-intubation. There are some immediate findings such as respiratory distress improved with increased audible air entry on the affected lung; decreased chest retractions; significant fall in respiratory rate and heart rate; arterial blood gases analysis showed significant improvement of pH, partial pressure of carbon dioxide

and oxygenation ratio and partial or nearly complete resolution of the atelectasis by chest radiograph check-up. Besides, the aspirated secretion in suction tube could also send for laboratory study if needed.

After the procedure, the premature infants must be intensive monitor for any acute complication such as hypoxia, pneumothorax, pulmonary bleeding. Because even flexible suction tube which diameter is smaller than bronchoscope could also damage airway mucosa and moreover perforations. Besides, intensive chest physiotherapy is still recommended even receive direct tracheobronchial suction for better airway clearance [6].

In conclusion, extremely premature infants have high risk to develop atelectasis after extubation. DTBS is a simple, effective and less invasive procedure to resolve post-extubation atelectasis and prevent re-intubation in tiny infants. Therefore, DTBS may be tried on premature infants with post-extubation atelectasis.

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