



## Editorial

### Extubation bundle, is it applicable to reduce the rate of reintubation, among preterm neonates?

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## Abstract

Respiratory support in the form of mechanical ventilation is a crucial intervention in premature neonates, with respiratory problems. However, prolonged mechanical ventilation and endotracheal intubation may be associated with major adverse effects, such as ventilation-associated pneumonia (VAP), pneumothorax, bronchopulmonary dysplasia (BPD) and periventricular hemorrhage.

To minimize such risks and complications, it is recommended to discontinue MV as soon as babies are able to maintain spontaneous breathing and achieve appropriate gas exchange with minimal respiratory effort. The ideal time for extubation is based on clinical and laboratory parameters assessed at the time of planned extubation. However, such parameters are not very objective, which makes extubation in NICUs a trial-and-error approach. Based on the morbidities associated with the long duration of MV in newborn babies, there is a clear need to establish objective criteria for extubation and avoid reintubation.

In this editorial, we will focus on the extubation bundle including modified spontaneous breathing trial (MODIFIED SBT) prior to extubation which can independently predict successful extubation in preterm babies.

**Key words:** Extubation, bundle, preterm, mechanical ventilation, neonates.

## Introduction

Respiratory support in the form of mechanical ventilation is a crucial intervention in premature neonates, with respiratory problems. However, prolonged mechanical ventilation and endotracheal intubation may be associated with major adverse effects, such as ventilation-associated pneumonia (VAP), pneumothorax, bronchopulmonary dysplasia (BPD) and periventricular hemorrhage. [1, 2]

To minimize such risks and complications, it is recommended to discontinue MV as soon as babies are able to maintain spontaneous breathing and achieve appropriate gas exchange with minimal respiratory effort. [2] The ideal time for extubation is based on clinical and laboratory parameters assessed at the time of planned extubation. However, such parameters are not very objective, which makes extubation in NICUs a trial-and-error approach. [2, 3]

Based on the morbidities associated with the long duration of MV in newborn babies, there is a clear need to establish objective criteria for extubation and avoid reintubation. [3, 7]

Failure of extubation has been associated with higher morbidity and mortality, increased length of hospital stay and more ventilator days. [8] Thus, identifying techniques for predicting successful extubation attempts may reduce mortality and morbidity associated with ill-timed extubation attempts.

Adequate brain maturity and lung function are prerequisites for successful transition from mechanical ventilation to spontaneous breathing among premature babies. In the absence of significant apneic episodes, bedside pulmonary function tests may be useful in conjunction with infant's clinical status and blood gas parameters to predict the success of extubation. [9, 10]

Data on pulmonary function tests prior to extubation in premature babies are

limited and conflicting. Most of the studies were conducted in babies with wide ranges of gestational age (GA), birth weight, and postnatal age at extubation and did not account for comorbidities such as patent ductus arteriosus (PDA), pulmonary hemorrhage, severe intracranial hemorrhage, atelectasis, and pneumonia after extubation that may contribute to the failure of extubation. [9-12]

Extubation bundle including modified spontaneous breathing trial (MODIFIED SBT) prior to extubation can independently predict successful extubation in preterm babies.

When the clinical team decides a newborn is ready for extubation based on the extubation bundle, a modified SBT (10 min) is used (Figure 1).

Extubation is considered successful when the babies are able to remain without invasive ventilatory support for 24 hours; extubation failure may be defined as the need for reintubation for any reason within 24 hours after extubation. The

time for extubation is to be determined by the medical staff based on clinical assessment and a designed extubation bundle (Table 1).

A modified SBT is to be performed when ventilated babies are ready for extubation, if failed SBT to be repeated until successful.

### **Conclusions**

Extubation bundle with modified spontaneous breathing trial (MODIFIED SBT) prior to elective extubation is recommended to be used in predicting successful extubation in premature babies. Guidelines for extubation among premature babies are needed in order to reduce unnecessary exposure to adverse effects of mechanical ventilation. Multicenter studies related to extubation guidelines in preterm babies are needed to improve the outcome and reduce morbidity and mortality in this age group.

### **Conflict of interest**

The author has no conflict of interests to declare.

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## References

1. Fávero RA, Schuster RC, Wojahn VW, Tartari JL. Incidence and main factors associated with extubation failure in premature newborns. *Pediatrics (São Paulo)*. 2011; 33(1):13-20.
2. Davidson J, Miyoshi MH, Santos AM, Carvalho WB. Measurement of respiratory rate and tidal volume to predict extubation failure of very low birth weight infants on mechanical ventilation. *Rev Paul Pediatr*. 2008; 26(1):36-42.
3. Cruces P, Donoso A, Montero M, López A, Fernández B, Díaz F, et al. Measurement of respiratory rate and tidal volume to predict extubation failure of very low birth weight infants on mechanical ventilation. *Rev Chil Med Intensiv*. 2008;23(1):12-7.
4. Newth CJ, Venkataraman S, Willson DF, Meert KL, Harrison R, Dean JM, Pollack M, Zimmerman J, Anand KJ, Carcillo JA, Nicholson CE; Eunice Shriver Kennedy National Institute of Child Health and Human Development Collaborative Pediatric Critical Care Research Network. Weaning and extubation readiness in pediatric patients. *Pediatr Crit Care Med*. 2009; 10(1):1-11.
5. Andrade LB, Melo TM, Morais DF, Lima MR, Albuquerque EC, Martimiano PH. Evaluation of the spontaneous breathing test in the extubation of preterm neonates. *Rev Bras Ter Intensiva*. 2010; 22(2):159-65.
6. Johnston C, Piva JP, Carvalho WB, Garcia PC, Fonseca MC, Hommerding PX. Predictors of extubation failure in children in the postoperative period of cardiac surgery undergoing mechanical

- pulmonary ventilation. *Rev Bras Ter Intensiva*. 2008; 20(1):57-62.
7. Kurachek SC, Newth CJ, Quasney MW, Rice T, Sachdeva RC, Patel NR, et al. Extubation failure in pediatric intensive care: a multiple-center study of risk factors and outcomes. *Crit Care Med*. 2003; 31(11):2657-64.
8. Paolo Biban, Marcella Gaffuri, Stefania Spaggiari, Davide Silvagni, Federico Zaglia, Pierantonio Santuz. Weaning newborn infants from mechanical ventilation. *Journal of Pediatric and Neonatal Individualized Medicine* 2013; 2 (2):e020225 doi: 10.7363/020225.
9. Veness-Meehan KA, Richter S, Davis JM. Pulmonary function testing prior to extubation in infants with respiratory distress syndrome. *Pediatr Pulmonol* 1990; 9:2–6.
10. Szymankiewicz M, Vidyasagar D, Gadzinowski J. Predictors of successful extubation of preterm low-birth-weight infants with respiratory distress syndrome. *Pediatr Crit Care Med* 2005; 6:44–49.
11. Balsan MJ, Jones JG, Watchko JF, Guthrie RD. Measurements of pulmonary mechanics prior to the elective extubation of neonates. *Pediatr Pulmonol* 1990; 9:238–243.
12. Kamlin CO, Davis PG, Morley CJ. Predicting successful extubation of very low birthweight infants. *Arch Dis Child Fetal Neonatal Ed* 2006; 91:F180–F183.

**Table 1: Extubation Bundle Elements**

Extubation Bundle Elements						
<b>Discuss readiness for extubation</b>	Baby triggering well (Adequate respiratory drive)		Mean Airway Pressure < 9 cm H2O	FiO2 < 30%	VT < 5 ml/kg	MODIFIED SBT Done
	Caffeine citrate	Weaned from sedation				

FiO2: fractionated inspired oxygen, VT: Tidal volume, MODIFIED SBT: modified spontaneous breathing trial

**Goal:**

1. SBT is a very good tool to assess patient readiness for extubation
2. Continuously assess readiness to wean ventilation
3. Consider extubation when patient can demonstrate adequate respiratory drive, PEEP < 6cmH2O, MAP 7cmH2O, either set or need to maintain < 4-5ml/kg, FiO2 30% or no change from Pre SBT oxygenation requirements

**Patient status:**

1. Stable Temperature (exception: therapeutic hypothermia)
2. Stable vital signs (HR > 100 bpm, SPO2 > 85%, spontaneous breathing)
3. Consider presence of gag reflex
4. Blood gases and or/Co2 monitoring in target ranges
5. Blood pressure stable without inotropes
6. Sedation reviewed
7. SPO2 within appropriate range as per NICU guideline or MD's order

**Ventilator Status:**

1. Set RR =/ < 45 bpm
2. Vt = 4-6 ml/kg
3. Mean airway pressure =/ < 7 cmH2O
4. PEEP =/ < 6cmH2O (if extubating to NIV-CMV may accept PEEP > 6cmH2O)
5. FiO2 =/ < 30%

**Spontaneous Breathing Trial Algorithm**

Switch to CPAP/PS mode

- PS 0/ maintain original PEEP for 3 minutes
- PS 5-8 cmH2O, with original PEEP for next 7 minutes

\*\* Total SBT time: 10 minutes

- Switch to CPAP mode with original PEEP for 3 minutes

- Switch to PSV mode for next 7 minutes. Delta P = 5-8cmH2O above original PEEP.

- Decrease RR to 1 bpm and IT =/ > .5 s

\*\* Total SBT time = 10 minutes

Assess for

NO

- \*\*Bradycardia < 100 bpm more than 5 seconds
- \*\*SPO2 < 85% despite 15% increase in FiO2
- \*\*Increase WOB as depicted by retraction

YES

YES

Ready to Extubate?

NO as per Medical Team

Continue to wean ventilation and reassess need for SBT

- \*Return to clinically appropriate ventilator setting
- \*Re-evaluate sedation needs and weaning if failure was due to poor respiratory drive

**Extubation:**

- \*Communicate with medical team around SBT result and obtain medical order to extubate
- \*Extubate within 1 hour of receiving order
  - ❖ CPAP/PS mode should be limited to maximum of 2-4 hours

Once extubated consider need for NIPPV

"Clinical guidelines are guidelines only. The interpretation and application of clinical guidelines will remain the responsibility of the

Figure 1: Algorithm for weaning from Conventional Ventilation using extubation bundle

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