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Spontaneous respiratory activity

Spontaneous respiratory activity



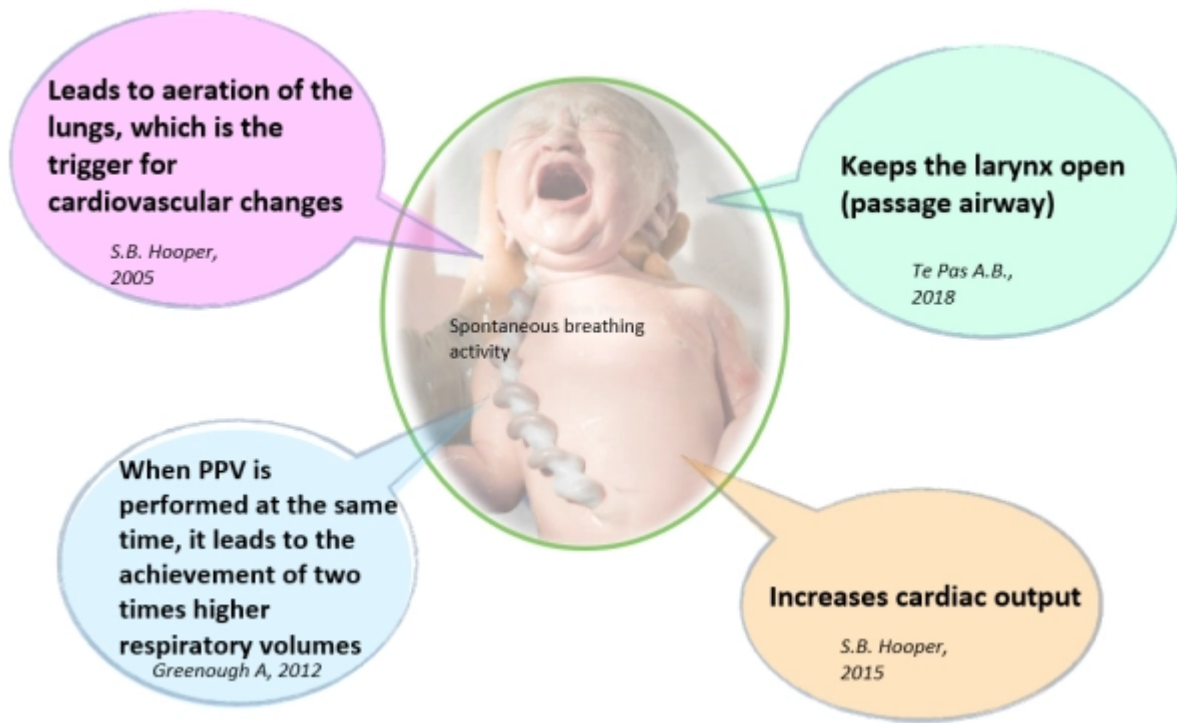
Spontaneous respiratory activity

Richard Plavka, MD., Professor

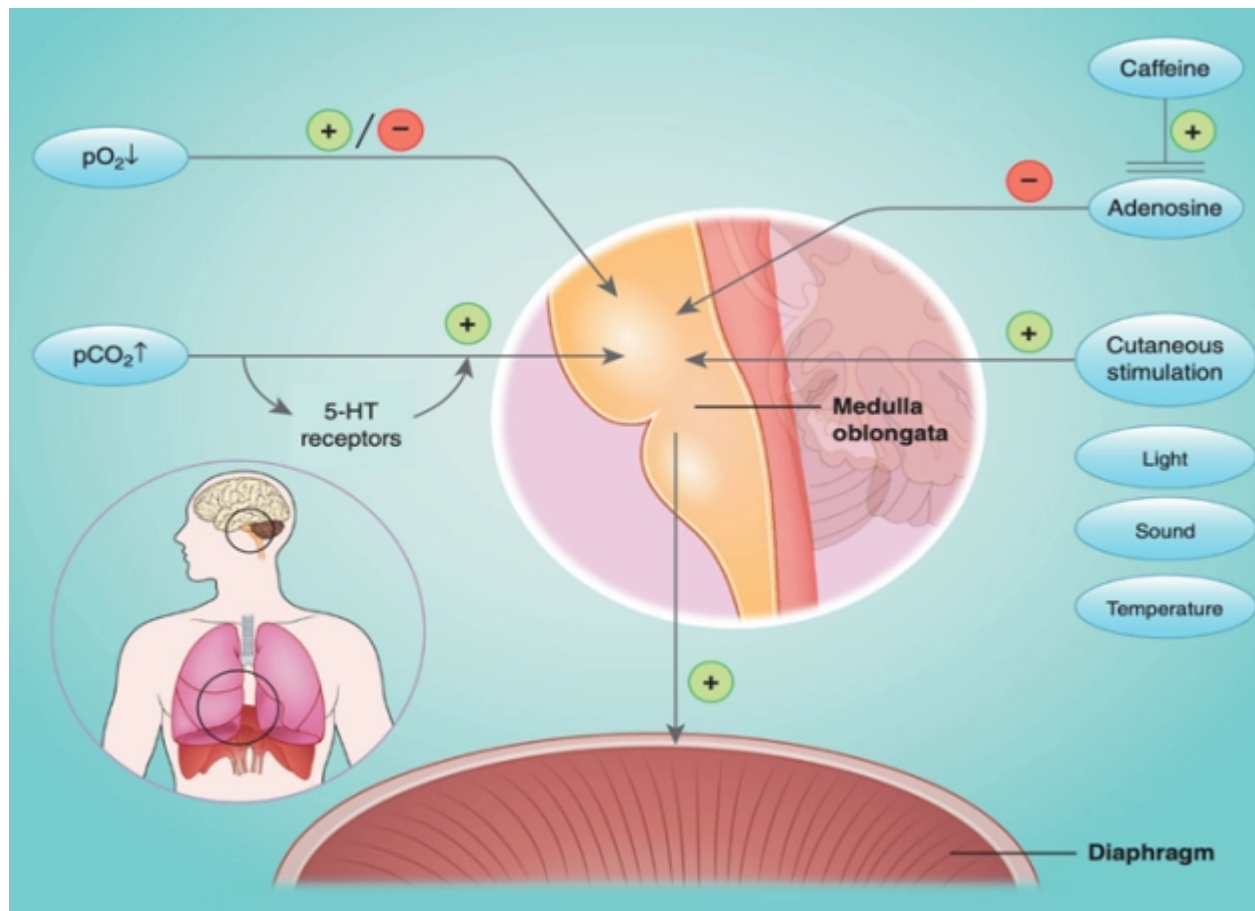


Spontaneous respiratory activity is the key to successful stabilization of premature newborns

Importance of spontaneous breathing activity for the adaptation of premature newborns

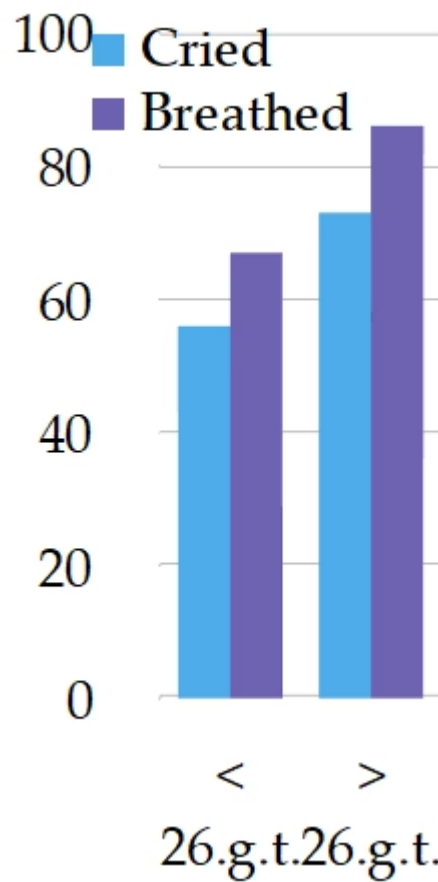


Initiation of spontaneous respiratory activity

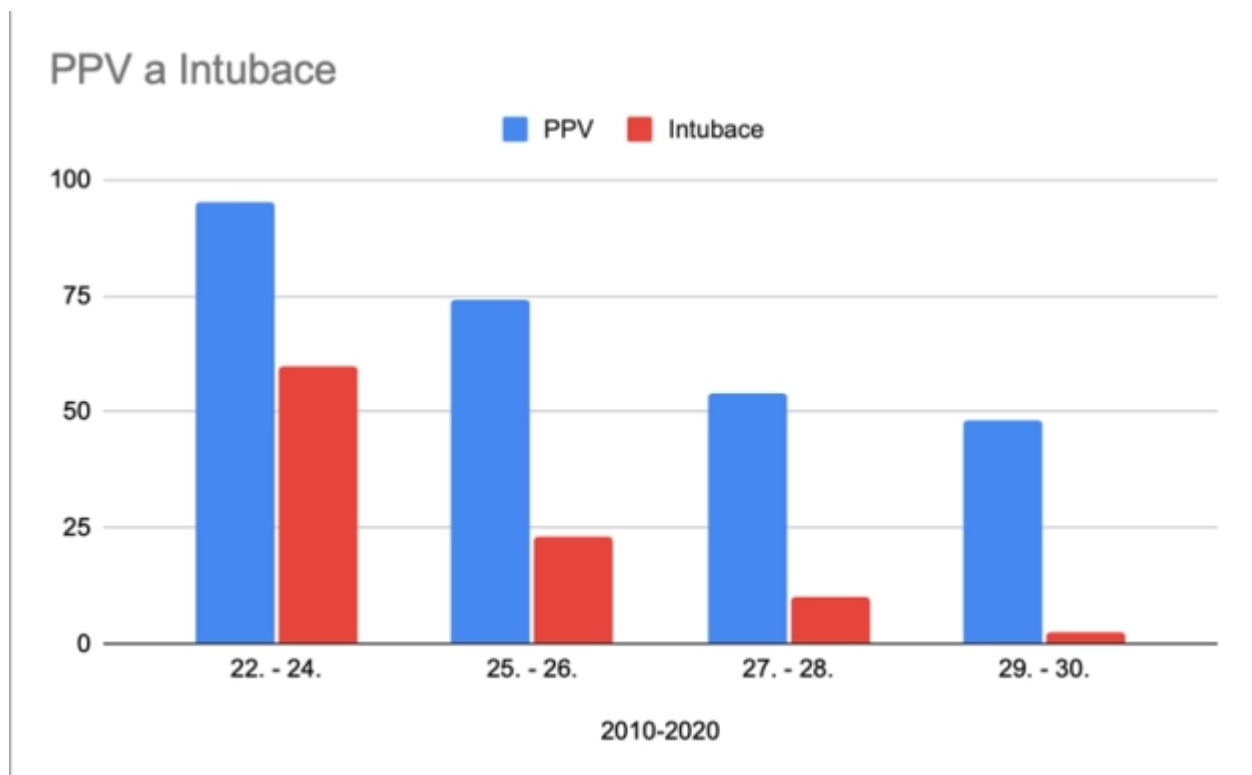


Initiation of spontaneous respiratory activity

- 80% of extremely premature newborns breathe spontaneously after birth (O'Donnell, 2010)
- 86% of premature newborns (under 32th) breathe during PPV in the delivery room (Shilleman, 2013)



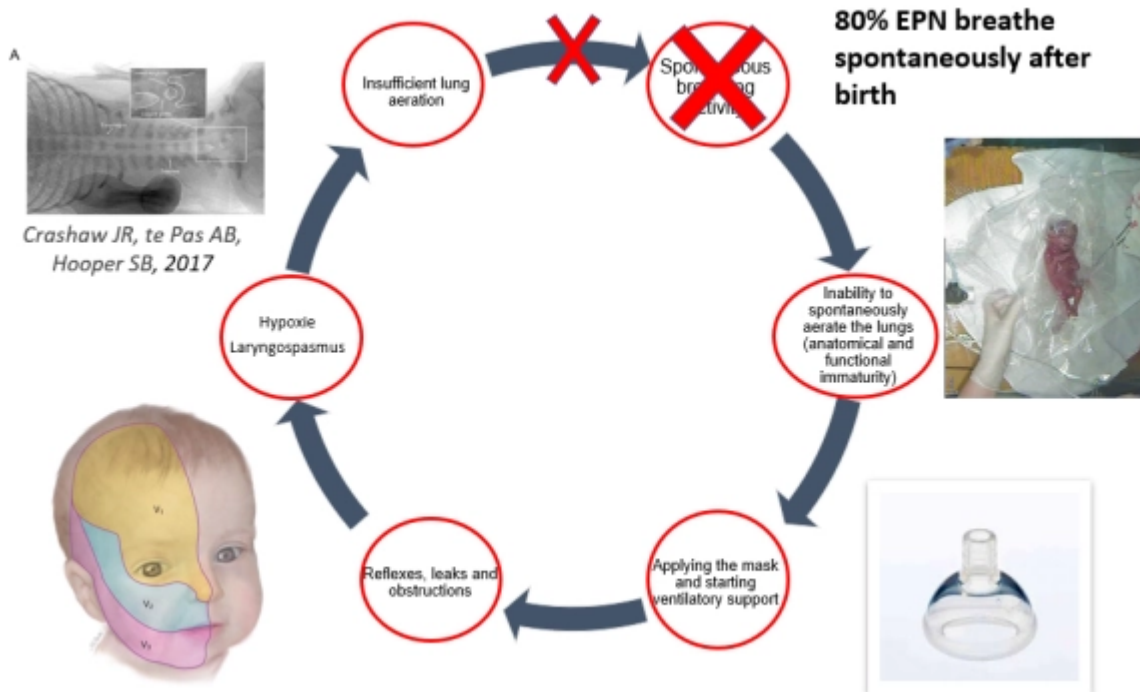
Paradox: Most premature newborns require PPV during delivery room stabilization



Why?

- Clinical monitoring of spontaneous respiratory activity (chest movements) in the delivery room is complex and imprecise (Poulton 2011; Shilleman, 2013)
- Anatomical and functional prematurity – extremely premature newborns are able to take their first breath but cannot spontaneously clear and aerate the lungs
- Our efforts tend to be counterproductive – irritation of reflex zones leads to iatrogenic inhibition of spontaneous breathing activity
- Secondary hypoxia

Spontaneous breathing activity is supported by gradual aeration of lungs



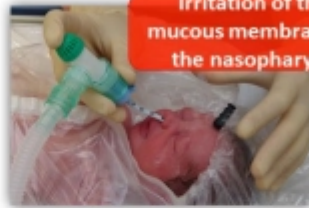
Reflexes negatively affecting spontaneous breathing

Applying of the mask



Trigemino - cardiac reflex (TCR)
→ apnea, bradycardia

Irritation of the mucous membrane of the nasopharynx



Laryngeal - chemo reflex (LCR)
→ laryngospasmus, apnea

Pressure support

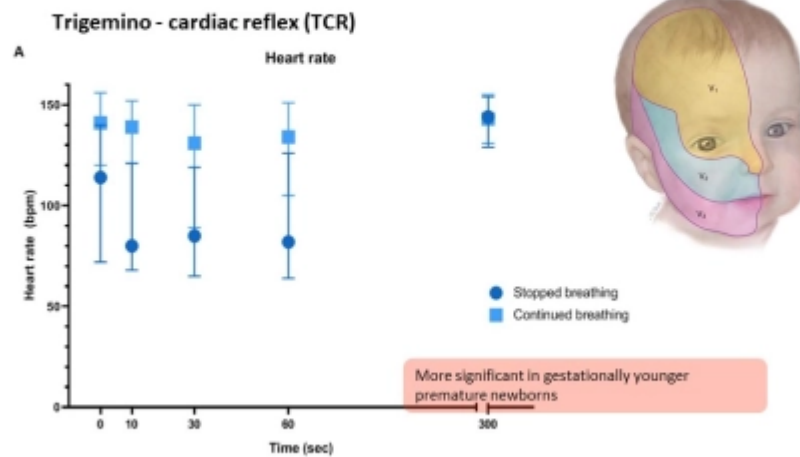


Activation of pressure-sensitive laryngeal receptors

→ laryngospasm, apnea
Hering-Breuer reflex
→ reduction in respiratory rate, decrease in vTE

Kuypers K, Lamberska T, te Pas AB, 2020

Apnea and reflex bradycardia during mask ventilation



Kuyperus K, Lamberska T, te Pas AB et al; 2019

Delayed ligation of the umbilical cord until the initiation of spontaneous respiratory activity





Custom-made resuscitation bed, manufacturer: Alfamedic, s.r.o.

Tactile stimulation (TS)

- Very little data



- Meta-analysis of 6 studies:
 - Wide variability among sites and patient groups
 - **In premature newborns, TS is performed less often**
 - TS is rarely performed within the first minute of life
 - **TS during the first 4 minutes of life improves oxygenation, especially in premature newborns**
 - Repetitive stimulation is more effective
 - TS during mask PPV can improve the development of spontaneous respiratory activity and does not increase the risk of leaks and obstructions

Pressurized ventilation support: stratification according to the maturity of the newborn



1. A periviable newborn initially requires a higher pressure and longer inspiratory duration to achieve optimal lung inflation
2. Gentle pressure support **synchronized with spontaneous breathing activity** (NAVA; Neurally Adjusted Ventilatory Assist, Graseby capsule)
3. Use of HFNC in the delivery room for gestationally older premature newborns

Interface

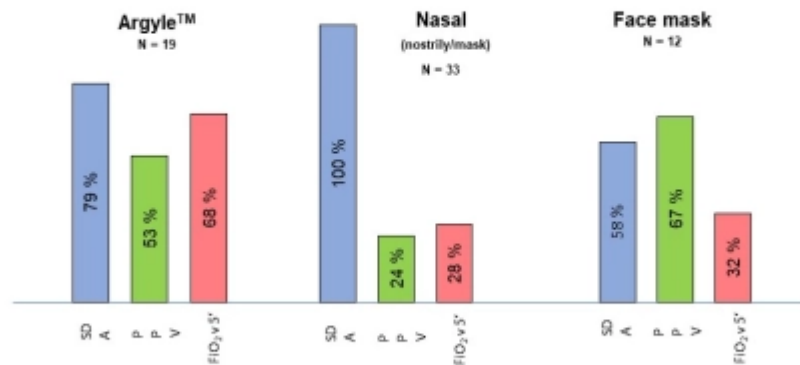
Author/year	Technique	Number	Primary outcome	Outcomes
Cappaso 2005		314/303	Intubation and indirect heart massage at the delivery room	Significant reduction in intubations and CPR in the group
Kamlin 2013		185/178	Intubation in first 24 hours of life	NS
O'Donnell 2013		72/72	PPV and intubation at the delivery room	NS

ILCOR 2021: mask or nasal cannula

- Data on periviable newborns are missing
- The use of a nostril/nasal mask remains a question



The effect of interface on the respiratory status and adaptation of premature newborns in the delivery room

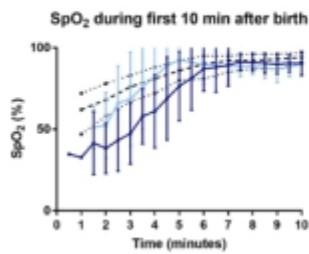


Period 2019–2020, GT 27⁺⁰ – 29⁺⁶, N=66

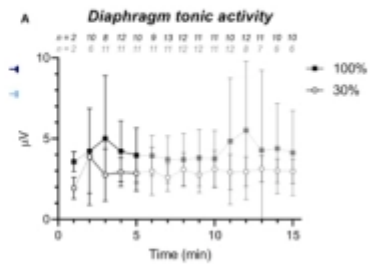
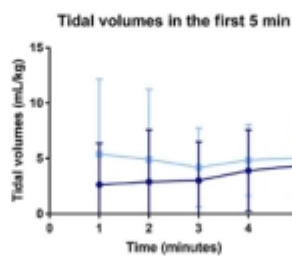
K. Dunajová, 2021

Oxygen therapy

ILCOR 2021: FiO₂ 0,3 pro ENN < 28 t.t.



Dekker J, 2019



van Leuteren RW, 2021

- Initial stabilization of premature newborns with 100% O₂ resulted in higher respiratory effort, better oxygenation, and shorter duration of PPV mask, without increased risk of oxidative stress.
- Diaphragm activity measured by electromyogram was significantly higher in premature newborns stabilized with 100% oxygen.

Caffeine in the delivery room

- Caffeine increases diaphragm activity and respiratory volume

Kraaijenka G. J. H. J. V. et al, The Effect of Caffeine on Diaphragmatic Activity and Tidal Volume in Preterm Infants. The Journal of Pediatrics (2015)

- A small randomized clinical trial showed a trend towards reduced number of intubations by 12 hours of life, significant increase in mean blood pressure and higher SVC

Katheria, A. C. et al. A pilot randomized controlled trial of early versus routine caffeine in extremely premature infants. Am. J. Perinatol. 32, 879–885 (2015)

- Administration of a caffeine bolus (10 mg/kg) immediately after birth was associated with improved respiratory function in premature newborns at < 30 weeks.

Dekker, J. et al. Caffeine to improve breathing effort of preterm infants at birth: a randomized controlled trial. Pediatr. Res. 82, 290–296 (2017).

Summary: support of spontaneous breathing activity and aeration of the lungs

- Delayed ligation of the umbilical cord
- Tactile stimulation

- Gentle pressure support ideally synchronized with spontaneous breaths
- Appropriate interface
- Oxygen therapy
- Caffeine application?

