Approach to Early Ventilation in Extremely Premature Infants

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Disclosure

- I have nothing to disclose.

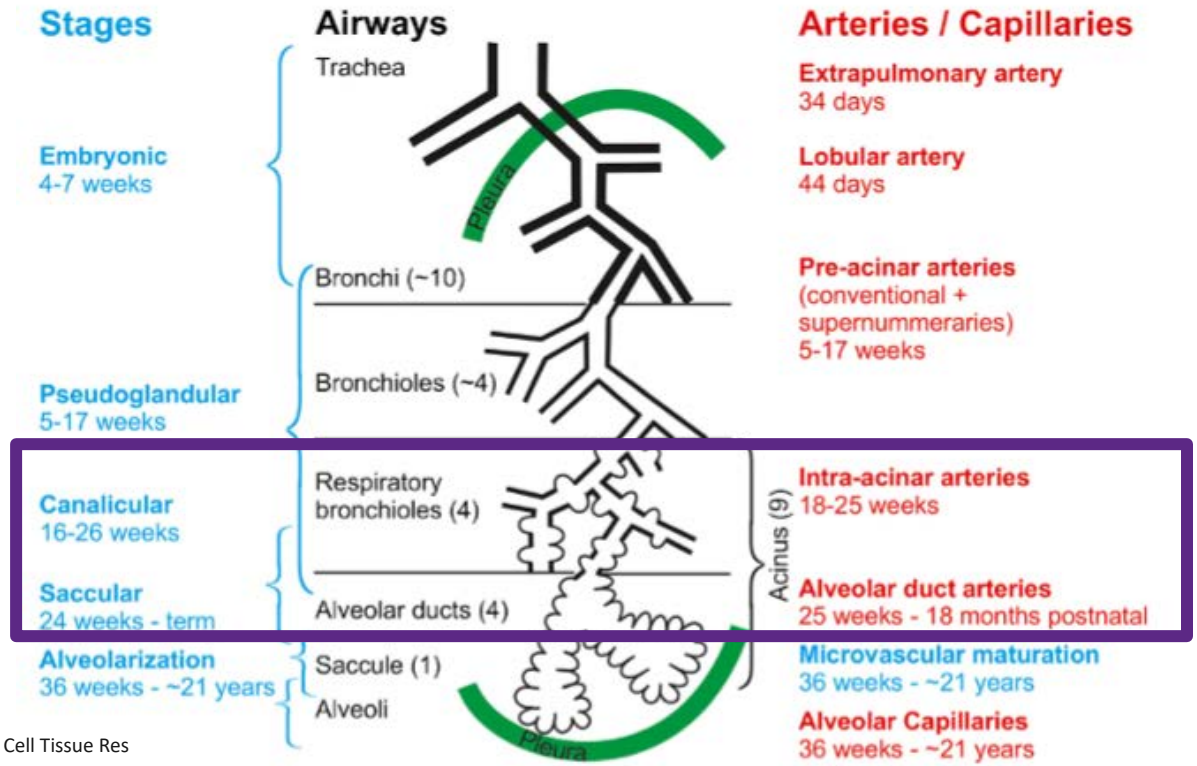
Objectives

- Review stages lung development
- Discuss goals of respiratory support in extremely low birth weight (ELBW) infants
- Understand the benefits of non-invasive ventilation
- Review evidence for various invasive ventilation techniques

Overview

- Extremely premature infants require prolonged respiratory support and are at high risk for morbidity and mortality from respiratory distress syndrome (RDS) in the first few days of life.
- Bronchopulmonary dysplasia (BPD) accounts for one of the main morbidities in surviving ELBW infants.
- Rates of morbidity, including BPD, are increasing as the age of periviability is decreasing and survival is increasing.
- Optimal ventilation techniques for this population is continually being investigated and vital for decreasing morbidity.

Stages of lung development



Schittny . Development of the lung. Cell Tissue Res

Goals of respiratory support

- Premature lungs, especially at the canalicular and saccular phases of development, are particularly susceptible to trauma including pulmonary interstitial emphysema, air leaks, and infection.[2]
- Prevent lung damage particularly volutrauma and barotrauma.
- Promote lung growth and development particularly alveolarization and proper angiogenesis.
- Prevent bronchopulmonary dysplasia (BPD)
  - Associated separately with poor neurodevelopment and decreased lung function (FEV_1) in adulthood.[2]

Non-invasive ventilation (NIV)

- NIV is the mainstay of respiratory support in ELBW infants and best modality to prevent BPD and ventilator-induced lung injury (VILI).
- It is utilized to maintain FRC in the easily collapsable lungs and decrease the need for invasive mechanical ventilation.
- Nasal CPAP is the most common non-invasive modality utilized
  - The optimal pressure aimed to maintain FRC is not known
  - Comparison of 7 - 9 cm H_20 versus 4 - 7 cm H_20 showed lower rates of reintubation in higher pressure group[3]
  - May have side effects including distension

Non-invasive ventilation (NIV)

- Non-invasive positive pressure ventilation (NIPPV) has been studied as first intention with efficacy in preventing need for mechanical ventilation, BPD, air leak, and nasal injuries[4]
- A RCT showed a 37% relative reduction in respiratory failure of NIPPV in comparison to nCPAP[5]
- Additional trials have shown a decrease in extubation failure with NIPPV[6]
  - NIPPV may lead to higher airway pressures over time leading to success[2]

Non-invasive ventilation

- Complications on NIV, especially in very preterm neonates occur, including nasal breakdown
  - Studies have shown efficacy in alternating mask and prongs with barriers to prevent nasal breakdown[7]

Invasive ventilation

- Overall, many ELBW infants, especially at 22 – 24 weeks may require invasive mechanical ventilation.
- Conventional ventilation has been the mainstay of neonatal care and historically utilized pressure-limited ventilation.
- Comparison of volume-limited ventilation to pressure-limited ventilation showed less hypocapnia and improved successful extubation in < 24 hours[8]
- Volume-control ventilation also showed improved weaning and shorter duration of MV in comparison to pressure-targeted ventilation.[9]
- Assist Control VG (AC/VG) is recommended as the additional triggered breaths result in decreased work of breathing and reduced pressure.[2]

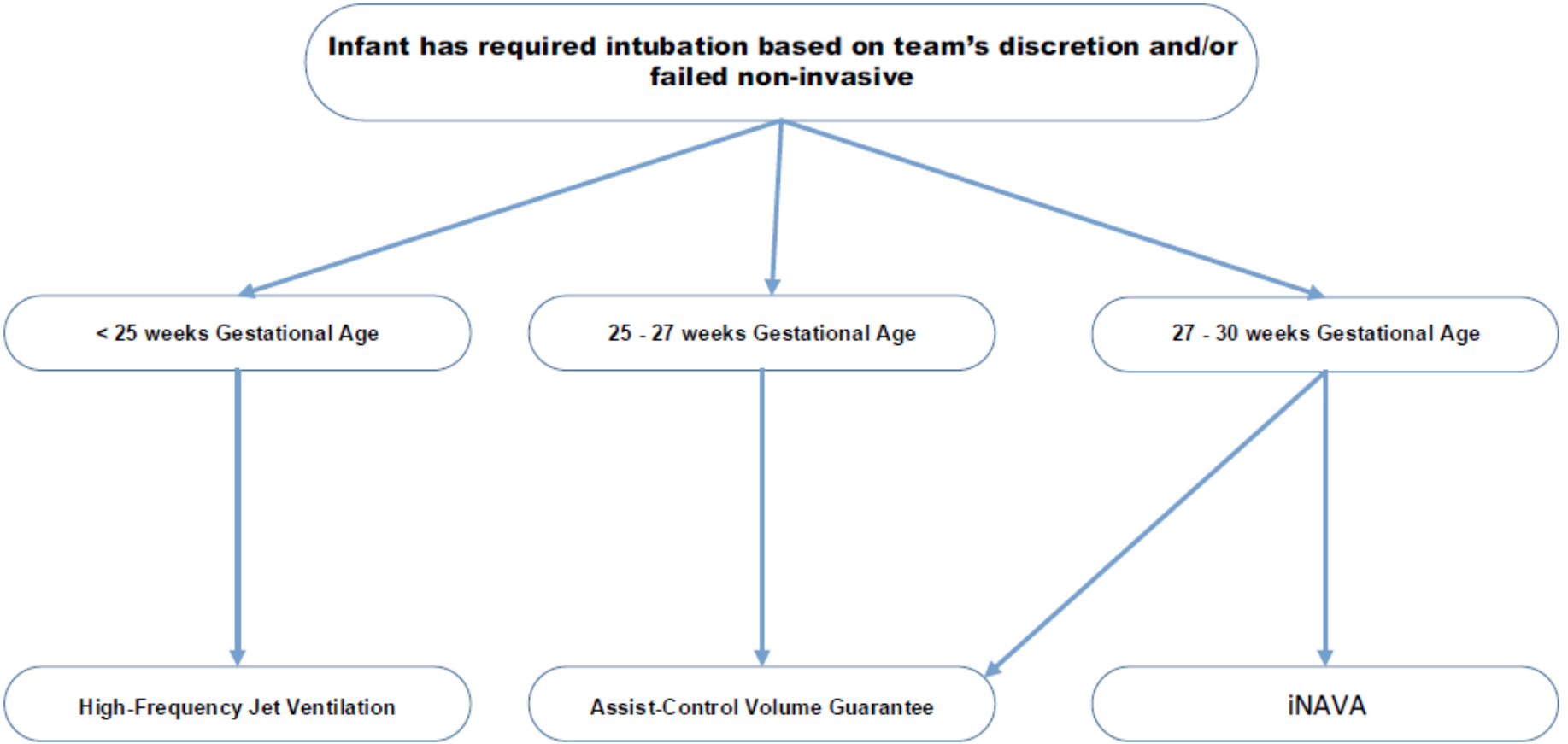
Invasive ventilation

- High-frequency oscillator ventilation (HFOV) is protective against volutrauma due to the small tidal volumes while allowing for open lungs at low airway pressures.[12]
- HFOV in comparison to CV have shown improvement in BPD.[2]
  - Slightly higher incident in air leaks
  - Decreased IVH due to decreased fluctuations in cerebral blood flow

Invasive ventilation

- High-frequency jet ventilation (HFJV) has become increasingly used as first-intention in ELBW neonates due to small tidal volumes and decreased alveolar exposure to high pressures.
  - HFJV may decrease BPD in comparison to conventional ventilation[10-11]
- Decrease in BPD rates was not necessarily seen when used as rescue modality.
  - However, there is improved survival and healing from air leaks in comparison to CV with HFJV.[11]

Management of an Intubated Infant Admitted to the LLUCH Tiny Baby Unit



Many more topics interrelated to optimal ventilation

- Antenatal corticosteroids
- Caffeine
- Surfactant
- Oxygen targets
- Postnatal corticosteroids
- Nutrition
- Many others!

Conclusions

- Optimal aspects of respiratory care will evolve as resuscitation of more extremely immature neonates continues.
- Promoting non-invasive respiratory support continues to be the best for preventing ventilator-induced lung injury in ELBW neonates.
- Volume-targeted ventilation, HFJV and HFOV are currently the most lung protective invasive ventilation modalities for ELBW neonates.

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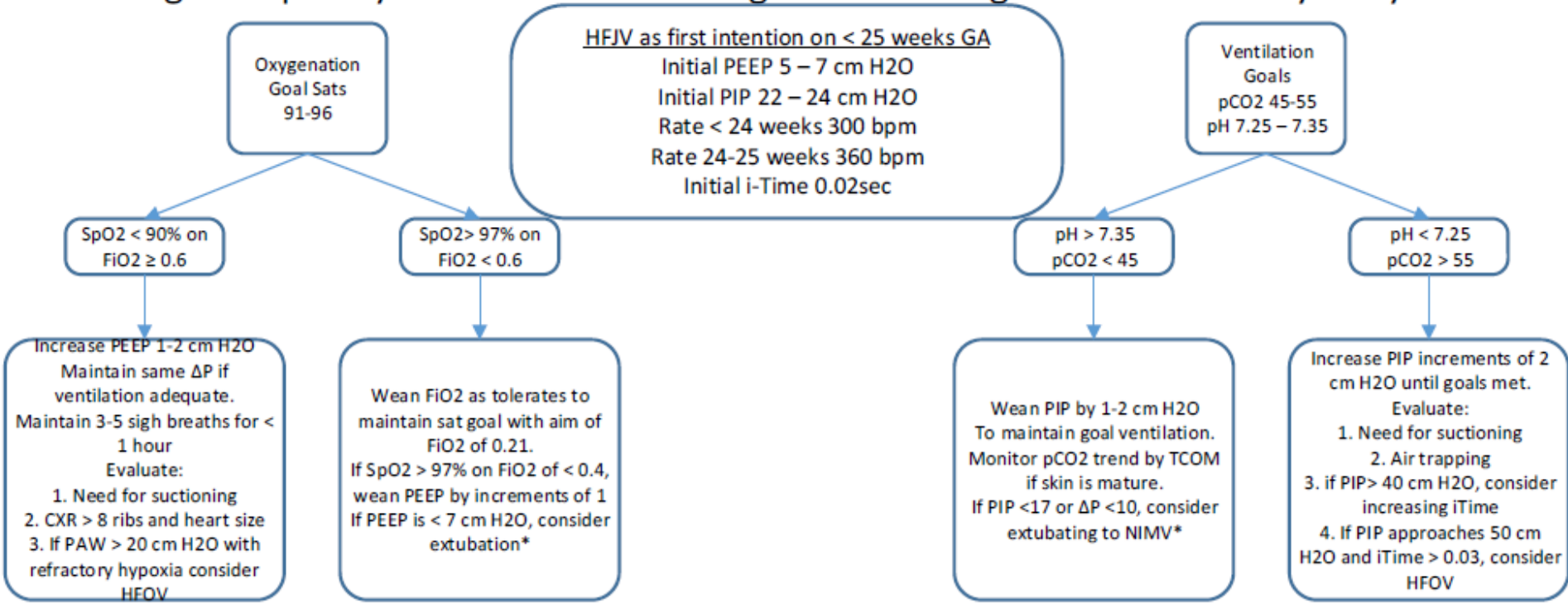
High Frequency Jet Ventilation Management Strategies for LLUCH Tiny Baby Unit



Assist-Control Volume Guarantee Management Strategies for the LLUCH Tiny Baby Unit