High Frequency Jet Ventilation Improves Gas Exchange In Extremely Premature Infants With Evolving Chronic Lung Disease (Retrospective Evaluation)

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Rational /Background: Disruption of development of gas exchange with partial/global respiratory failure, as a result of lower alveolarization as well as disturbed small airway function and inflammation, is the main cause of death in infants with evolving chronic lung disease. Biophysical principle of HFJV, characterized by the axial jet stream of gas mixture achieving the alveoli spaces quickly during very short inspiration time and expired gas swirling out around the inspired gas, can provide superior alveolar ventilation and oxygenation to the other artificial ventilatory modes especially when the small airways disease of lung is dominated. Increasing tidal volumes and high fraction of inspired oxygen used during the mechanical ventilation emphasize the ventilator-induced injury and vicious circle has been closing.

Objective: To describe the response to high frequency jet ventilation (HFJV) in extremely premature infants (EPI) with refractory respiratory worsening on patient-triggered conventional ventilation and high frequency oscillation (HFO).

Design: Retrospective evaluation of demographics, ventilator settings, blood gas analysis, and calculated oxygenation index (0I) prior to and during 72 hours and further next days of HFJV until the extubation or crossover back..

Setting: Tertiary Regional Neonatal Intensive Care Unit of the Perinatology Center in Prague. Patients and Interventions: In six extremely premature infants evolving CLD with median gestational age 24.0 wks (range 22±3 - 26±3) and median birth weight 660 g (range 470-1020 g), 8 occasions of refractory respiratory failure developed during the artificial ventilation (4 on PSV-VG, 2 on SIMV-VG, 1 on SIMV and 1 on HFOV). HFJV (Life Pulse HFJV, Bunnell lnc.) was indicated when gradual apparent increasing 0I > 10 or tidal volumes (V t) > 7ml/kg to maintain $C0_2 \geq 60$ mmHg occurred. The high volume strategy (HVS) with optimal lung inflation was the main principle of HFJV therapy with adjustment of the pressure amplitude ($\triangle P$) to achieve adequate vibration of the thorax and maintain $C0_2$ in the range 45 - 55 mmHg. The inspiratory time 0.02 seconds and frequency 310-420/min were set initially. The ventilatory stabilization and weaning from artificial ventilation to nasal CPAP were the targets of this approach. Three days postnatal steroid course was started only 24 hours before planned extubation.

Results: All patients survived. Median PEEP, $Fi0_2$ and V_T of conventional ventilation were 7 cm H_2O (range 6.1 - 10.0 cm $_{H2O}$), 0.30 (range 0.24 - 0.5) and 7.0 ml/kg (range 5.2 - 8.0 ml/kg), and Paw, Fi02 and V_T on HFOV were 10.5 cm $_{H2O}$, 0.45 and 3.6 ml/kg before crossover to HFJV. Median postnatal age of HFJV outset was 27 days (range 15-155 days). The median 0I decreased from 11.2 to 8.1 during the first 24 hours and remained at this level for the next 48 hours to decrease furthermore to 4.8 after postnatal

dexamethasone administration before the extubation. Median C02 levels decreased from 60 to 46 mmHg after 3 hours of HFJV and remained in target levels until the extubation. Median duration of HFJV was 11.5 days. Six patients in 7 occasions of refractory respiratory worsening were extubated to nasal CPAP successfully. All patients required oxygen supplementation at 36 postconceptional weeks and the median oxygen requirement was 105 days (range 85- 151 days).

Conclusion: HFJV can improve gas exchange and facilitate the weaning from artificial ventilation during evolving CLD in EPI. Checking of the development of CLD in high-risk group of EPI by early moderate introduction of HFJV can be hypothesized and warrants prospective randomized trial.