

Successful Use of a Prolonged Inspiratory Time on the Bunnell Life Pulse HFJV in Treating Pneumonia Refractory to Conventional and HFOV Ventilation in a NICU Patient

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Objective: Case report of the successful use of a non-traditional longer inspiratory time on the Bunnell Life Pulse HFJV in a NICU baby with pneumonia where oxygenation and ventilation were refractory to conventional ventilation and the Sensormedics HFOV modes of treatment. The result was marked improvement in oxygenation and ventilation as well as improvement of chest radiographs (CXR) and capillary blood gases (CBGs).

Patient: A 28 5/7 week PMA female who developed a culture-negative RUL pneumonia on day of life 56 (D#56). At birth she was intubated, received prophylactic surfactant replacement therapy with Survanta, and placed on conventional ventilatory support. She was electively extubated to NCPAP on D# 3 and maintained on NCPAP or high-flow nasal cannula until she developed an acute feeding intolerance on D#55. Intravenous access was difficult and Broviac placement was required on D#56. She was intubated for the surgical procedure and returned to the NICU on conventional ventilatory support on the Viasys AVEA with settings: rate 40, target volume 4-6 ml/kg (inspiratory pressure 22), PEEP 6. Attempts to wean her rate to 30 were unsuccessful and she required increasing F_{iO_2} to maintain saturations > 88%. Within 24 hours she developed a right upper lobe consolidation consistent with clinical pneumonia and required increased ventilatory support. On the AVEA settings increased: rate 40, PEEP 8, with resultant CBG: 7.21/90/34/36/+5. On D#57, she was changed to the SensorMedics 3100A HFOV with settings: P_{AW} 18, Amplitude 44, Hz 6. Next CBG drawn 30 minutes later was: 7.27/79/43/36/+6.5. Over the next week she showed no significant improvement and no ability to be weaned on HFOV settings despite IV antibiotic therapy, inhaled Tobramycin, and rigorous pulmonary toilet including chest physiotherapy and frequent suctioning. On D#67 HFOV settings were P_{AW} 22, Amplitude 43 and Hz 6 with associated CBG 7.34/70/38/38/+9.

Intervention: On D#68 the decision was made to change ventilation strategy. She was changed to the Bunnell Life Pulse HFJV on settings of PIP 45, PEEP 15, Rate of 240, and T_i 0.02s. CBG drawn 30 minutes afterward: 7.3/75/37/37/+7.6. Consideration was given to the difference in time constants in the consolidated region, the need to recruit this area, and a desire to not increase P_{AW} by increasing PEEP any further; in fact, a decrease in PEEP while maintaining P_{AW} was desired. Therefore, a trial of increasing the $T_i = 0.03s$ was undertaken.

Measurements: Serial CXRs and CBGs were obtained in conjunction with hemodynamic monitoring and frequent physical assessment to evaluate the efficacy of the HFJV interventions, and determine the ability to wean ventilatory support.

Patient Results: After 30 minutes with the $T_i = 0.03s$ showed the $PCO_2 = 70$. She continued to require frequent suctioning for copious amounts of secretions. Her CXR showed slightly improved aeration in the RUL after 3 hours of HFJV with $T_i = 0.03s$. Settings were weaned cautiously and the amplitude (ΔP of 30) was intentionally maintained. She continued to show improvement in PCO_2 and slowly decreased her F_{iO_2} requirement. On D#75 HFJV settings: PIP 33, PEEP 8, Rate 240, T_i 0.03s. P_{AW} measured 13.5cmH₂O; CBG at that time: 7.42/55/58/36/+9. CXR showed improvement in RUL recruitment. At this time she was transitioned to the AVEA with settings of target volumes 5-7 ml/kg (inspiratory pressure 24), rate 30, PEEP 8. P_{AW} on those settings was 13cmH₂O, and her F_{iO_2} requirements were now consistently below 35%.

Conclusions: Changing to the Bunnell Life Pulse HFJV proved to be an effective strategy for improvement in both the removal of secretions and lung recruitment. Increasing the inspiratory time to $T_i = 0.03s$ provided the compensatory yet necessary contribution to the P_{AW} while allowing the PEEP to be weaned from 15 to 8 over a 7 day period. This change in strategy combined with intentionally weaning PIP and PEEP together to maintain constant amplitude ($\Delta P = 30$) in the initial phases also resulted in ventilation parameters being weaned slowly but significantly. The consolidated lung, previously refractory to interventions with convention ventilation, HFOV, and aggressive pulmonary hygiene therapies, was successfully recruited.