

Utilizing High Frequency Jet Ventilation to Monitor and Replicate High Frequency Oscillatory Ventilation

Andora Bass, MD, Michael Gentile, RRT, John Heinz, RRT, and Ira Cheifetz, MD
Division of Pediatric Critical Care Duke University Medical Center, Durham, NC

Background: High frequency ventilation can be delivered using different technologies: oscillatory ventilation (HFOV) and jet ventilation (HFJV). However, HFOV displays mean airway pressure (Paw) and amplitude (ΔP) whereas HFJV displays peak inspiratory pressure (PIP) and positive end expiratory pressure (PEEP). This difference may make replicating the settings on the two ventilators problematic, especially if a practitioner is more familiar with one device than the other.

Objective: The study objectives are: 1) to validate the use of a high-frequency jet ventilator (Life Pulse; Bunnell, Inc, Salt Lake City, UT) as a monitoring device during HFOV (SensorMedics 3100A; Viasys Healthcare, Yorba Linda, CA); and 2) to use HFJV measurements to calculate the PEEP necessary during HFJV to approximate Paw during HFOV.

Design/Methods: A pneumotachometer (NICO₂ Respiratory Profile Monitor; Respironics Inc., Wallingford, CT) was placed in-line between a HFOV circuit and a pediatric lung model to measure Paw, PEEP and PIP. We then studied 36 HFOV setting combinations in a random order. HFJV was also placed in-line via the LifePort adapter to determine if the NICO and HFJV measurements correlated.

Using HFJV as the monitoring device, the same 36 combinations of HFOV settings were repeated, and Paw, PIP, PEEP, and ΔP were recorded. After each combination, HFJV was placed in-line with the Avea (Viasys Healthcare, Yorba Linda, CA) conventional mechanical ventilator. HFJV was set at the same rate and PIP as during HFOV. The only variable was the PEEP setting on the background conventional ventilator (which was in CPAP mode). We calculated the Paw contributed by the PIP, rate, and inspiratory time set during HFJV and subtracted this from the goal Paw. This value was the PEEP that we predicted would be required to match Paw on HFJV to HFOV (predicted PEEP).

Results: The correlation coefficient between the NICO₂ and HFJV measurements was 0.999 ($p < 0.0001$; mean difference 0.62 ± 0.30 ; $p < 0.0001$). The predicted PEEP calculated and the actual PEEP required is highly correlated with a correlation coefficient of 0.991 ($p < 0.0001$). The mean difference in these values is not statistically significantly different from zero (mean difference 0.25 ± 1.02 ; $p > 0.15$).

Conclusions: HFJV accurately monitors pressure delivery during HFOV. These measurements can then be successfully used to calculate the predicted PEEP necessary to match Paw on the two types of high-frequency ventilators. Replicating the Paw with adequate PEEP on HFJV will simplify the transition between ventilators and may result in improved oxygenation.