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Advances in pulmonary management of the critically ill infant

bunnell INSPIRED INFANT CARE

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New Life Pulse Research: The Australia Connection

Proper PEEP management is critical to success when using the Life Pulse. Progress reports on recent research from Australia have added objective evidence on how to choose CMV settings (PEEP, Rate, PIP, inspiratory time) during HFJV.

Three years ago Jane Pillow, FRACP, PhD at the University of Western Australia in Perth, initiated a series of animal studies with PhD candidate and veterinary anesthesiologist, Gabby Musk, DVM and fetal physiologist Dr. Graeme Polglase. The purpose of these preterm lamb studies was to evaluate the effects of PEEP and CMV breaths during HFJV on gas exchange and lung injury, and early results were presented at the 2008-09 Snowbird HFV and 2010 Pediatric Academic Society (PAS) meetings.

The studies compared keeping PEEP constant at 5 cm H_2O versus adjusting PEEP to aid in optimizing lung volume after Cesarean section delivery of preterm lambs. Using CMV breaths to recruit collapsed alveoli was examined in later studies.

Adjusting PEEP from 5 to 12 to 8 cm H_2O over the first hour then holding PEEP at 8 cm H_2O for the second hour resulted in lower delta pressure and tidal volume to keep $PaCO_2$ 45-55 mmHg. FiO_2 and oxygen index were also lower.

Postmortem static lung compliance was better in lambs randomized to the adjusted PEEP group compared to lambs where PEEP was kept constant at 5 cm H_2O. Inflammatory markers and pulmonary blood flow were not statistically different in the two groups, but there were strong and consistent trends in all inflammatory markers towards less lung injury in the adjusted PEEP group. Pulsatility index was higher in the adjusted PEEP group during the first hour suggestive of increased pulmonary vascular resistance, but was not different from the constant PEEP group once PEEP was decreased to 8 cm H_2O.

Later lamb studies from Professor Pillow and Drs. Musk and Polglase focused on the value of CMV breaths during HFJV. PEEP was kept at 8 cm H_2O for these studies based upon the outcome of the earlier study and to isolate the effect of the CMV breath on recruitment. CMV rate, inspiratory time, and PIP were evaluated independently.

The preterm lambs could be successfully ventilated with various combinations of CMV and HFJV. There was no advantage to using 20 versus 5 bpm, 2.0 versus 0.5 second inspiratory times, or CMV PIP that interrupted versus PIP that didn't interrupt HFJV. There was some evidence that lung injury may be greater with longer I-time, higher rate, and larger tidal volume

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CMV, but analyses of those data were incomplete at the time of these progress reports.

Discussion

Mean airway pressure (MAP) keeps lungs open, enabling oxygenation. The correlation between MAP and oxygenation during HFOV is well understood, but the contribution of PEEP to MAP during HFJV is less understood. HFJV typically adds 2-5 cm H_2O to MAP depending on the set HFJV PIP because the inspiratory time is so brief (0.02 sec). Therefore, PEEP contributes much more to MAP than HFJV PIP. To match a MAP of 15 cm H_2O during HFOV using HFJV, one would have to use a PEEP of 12-13 cm H_2O.

Conclusions

The studies of Drs. Musk, Pillow, Polglase, and colleagues from Perth support and refine the strategies that we have found to be most effective over the past 27 years of HFJV treatment of preterm infants:

1. Adequate gas exchange can be achieved during HFJV with or without CMV breaths.

2. Using HFJV with optimal PEEP (e.g., 8 cm H_2O) and no CMV breaths may produce the best gas exchange, facilitate better lung compliance, and decrease lung injury.

3. Adding CMV breaths to HFJV may improve oxygenation by recruiting lung volume, but using fewer, smaller CMV breaths with optimal PEEP seems prudent.

4. Using HFJV with a low PEEP (5 cm H_2O) and no "background" CMV breaths may not be the best strategy for success.

Data from these studies has been submitted for publication and will likely begin appearing in journals in the next year or two. We look forward to the final reports from Drs. Musk, Pillow, and Polglase.

Snowbird HFV Presentations 2010

New case studies presented at this year's High-Frequency Conference at the Snowbird Ski Resort highlighted the ongoing success of the Life Pulse. These presentations raised important questions about when and how the Life Pulse is utilized. Of the seven HFJV presentations three presentations were bench studies and four were clinical case studies.

The four HFJV case presentations addressed different diagnoses - congential diaphragmatic hernia, pulmonary hypoplasia, complete tracheal rings, and a hypoplastic left heart variant - but the courses of each case were remarkably similar.

The patients were initially supported on conventional ventilation but they deteriorated with increasing hypercarbia or hypoxemia or both. Physicians switched the patients to the Life Pulse and the infants stabilized within 24 hours, allowing for surgical repair, recovery, and eventual discharge.

Conclusions from these presentations are similar: the Life Pulse ventilator continues to save lives when conventional ventilation fails. We have heard such case studies presentations repeatedly over the last 25 years.

During the Q&A following one of the presentations, this question was asked, "If the Life Pulse is such a good rescue ventilator, why isn't it used earlier before rescue is necessary?"

The answer is that most NICUs do not have guidelines that help determine when conventional ventilation has failed. Earlier recognition of conventional ventilation failure prevents further lung injury and results in prompt benefits with the help of HFJV.

Some say conventional ventilation has failed when the PIP > 22 cm H_2O and the PCO_2 > 55 mm Hg, or when MAP > 10 cm H_2O and the PO2 < 50 mm Hg with a FiO_2 > .60, or when the pH < 7.20. What are your criteria? Are they accepted by your whole team?

These are basic questions, yet few NICUs have such guidelines and even fewer adhere to them routinely. Why are infants exposed to high pressures or volumes when HFJV minimizes these detrimental factors? Why wait to confirm lung injury before implementing HFJV? You can change this "rescue" mentality for using HFJV. Take this issue to your Performance Improvement or QA committee and develop conventional ventilator failure guidelines for your NICU. Document your outcomes before and after implementing the new guidelines so you can study and track their benefits.

After 27 years of clinical experience there is no question that HFJV saves lives. Why not reap the benefits of HFJV sooner by establishing simple guidelines for when and how HFJV is implemented? Let's prevent lung injury.

Bunnell's New Website

Bunnell has launched a new website designed to help you learn about the Life Pulse systems and HFJV patient management. You will find the new website is easier to navigate with links to new content and updated information.

The most exciting new feature is our expanded educational content. You can now access our HFJV training videos 24/7. Our complete in-service training video, patient management guidelines, and a thorough alarms and troubleshooting presentation are just a click away.

Log on at www.bunl.com and take a test drive. We would love to get your feedback; click on the Contact tab in the main menu and send us your thoughts.

Clinical Bulletin: New Suctioning Procedure

Bunnell recently mailed a Clinical Bulletin to all Life Pulse customers regarding our latest recommendation for suctioning patients being treated on the Life Pulse: place the Life Pulse in the Standby mode prior to suctioning.

Place the Life Pulse in the Standby mode prior to suctioning.

The Clinical Bulletin explains that the recommendation for switching to Standby mode is based on feedback from some customers who experienced alarms while suctioning with the Life Pulse running (not in Standby). Loss of PIP, High PIP, and in some cases Ventilator Fault 10 alarms have been reported.

Issues associated with these alarms and their troubleshooting may be magnified when patients are receiving iNO. Nitric Oxide overshoots and in extreme cases a Delivery Failure alarm may result. Ikaria issued a Technical Bulletin (CL-TB-0041) on this topic March 2010.

As a result of customer feedback and the testing done by Bunnell and Ikaria, we decided the simplest and the safest recommendation is to place the Life Pulse in the Standby mode prior to suctioning.

If you have any questions or concerns about this recommendation, please contact your Clinical Specialist or Bunnell's Clinical Support staff at 800.800.4358 (HFJV).

3.0 mm LifePort Adapter

Bunnell is happy to report the new 3.0 mm LifePort adapter was submitted to the FDA in May 2010 for approval. Federal approval could come by the end of 2010 or early in 2011.

Bunnell will notify all Life Pulse customers when we receive our final approval. Ordering information will be provided at the time of the announcement.

Two 3.0 mm LifePorts will be included in the Patient Circuit Kit along with two 2.5 mm and two 3.5 mm LifePorts and two Life Pulse Circuits. The new 3.0 mm LifePorts will also be available to purchase in boxes of 10 each, like the other LifePort adapter sizes.

The 3.0 mm LifePort is one more example of Bunnell responding to clinicians' suggestions to improve patient care.

Sound Reduction Upgrade

Bunnell continues to improve patient care with on-going upgrades of the "WhisperJet" Patient Box. The upgrade, which began in November 2009, significantly reduces sound output from an average 56 dB to 41 dB (using an A-weight averaging meter) This is 4 dB below the American Academy of Pediatrics recommended level of 45 dB for NICUs.

Patient Boxes under warranty or service contract will be upgraded at no charge. The upgrade is included at no charge on all Patient Boxes returned for routine preventive maintenance (PM) service. Hospitals that send in Patient Boxes exclusively for the sound reduction upgrade will be charged $175.

The upgrade program is being coordinated through Bunnell's customer service department. To initiate the upgrade process, call 800.800.4358 ext. 6 for a Return Authorization number (RA#). Please have a Purchase Order number available when you call for your RA#.

Service Seminar 2011

Bunnell will hold its annual Service Seminar in Salt Lake City, Utah in September 2011. The two-day class is a technical service training program geared toward clinical engineers and biomedical technicians.

The program covers the theory of operation, clinical troubleshooting, bench top evaluation, and preventative maintenance procedures. The registration fee of $1,200 includes ground transportation, continental breakfast, and lunch as well as a service manual and test equipment unique to the Life Pulse ventilator.

Class size is limited to eight participants and is reserved on a first-come first-serve basis, so register early. The class agenda and registration form are available on the Bunnell website at www.bunl.com under the Technical menu. For additional information on registration or hotel accommodations, contact Dave Platt at 800-800-4358 ext. 115 or plattdr@bunl.com.