

Technology & Clinical REPORT

Fall 2006

Vol. XI, No. 1

Advances in
pulmonary management of
the critically ill infant

bunnell
INSPIRED INFANT CARE

Inside this Issue

iNO for PPHN -
HFJV vs. HFOV

Expanding
Regional
Representation

Infant Star HFV
Trade-In Program

Using a UPS with
the Life Pulse

Jet Papers and
Studies

PRN In-service
Trainers Wanted

Biomed Tech
Training Program

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Understanding the Keys to Success

Having a clear understanding of how the Life Pulse works is essential to maximize its benefits. The keys to understanding HFJV are an appreciation of inspiratory time (I-time), the jet nozzle, and passive exhalation.

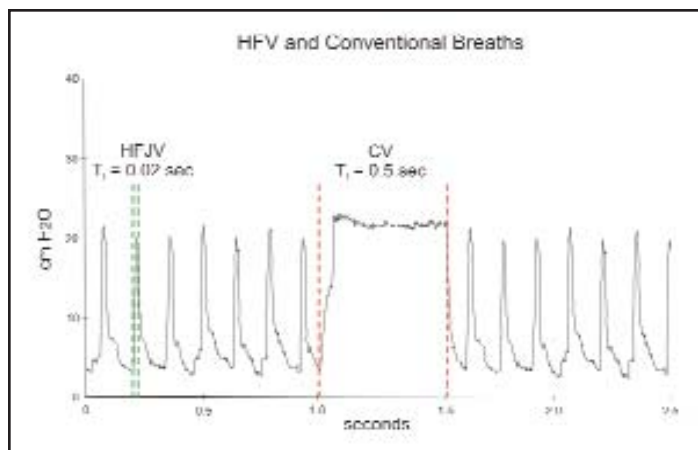
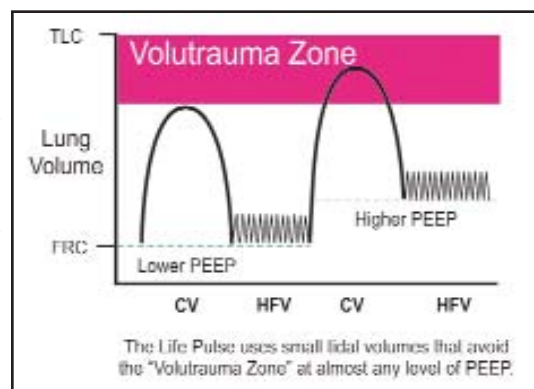
Inspiratory Time:

The 0.02 sec I-time used during HFJV is 25 times shorter than a 0.5 sec I-time used during conventional ventilation. As a result, tidal volumes delivered dur-

allow higher levels of PEEP to be used safely, keeping the lungs open with sufficient mean airway pressure (MAP) to oxygenate.

Short I-times provide two of the most important benefits of HFJV: small tidal volumes and low alveolar pressures. Small tidal volumes, when delivered with short I-times, make it impossible for the peak pressure used during

time is set as a percentage of the respiratory cycle. Therefore, as HFJV rate is adjusted, the only thing that changes is



ing HFJV are approximately 10 times smaller than those used during CV. These very small tidal volumes

HFJV to be transmitted to alveoli.

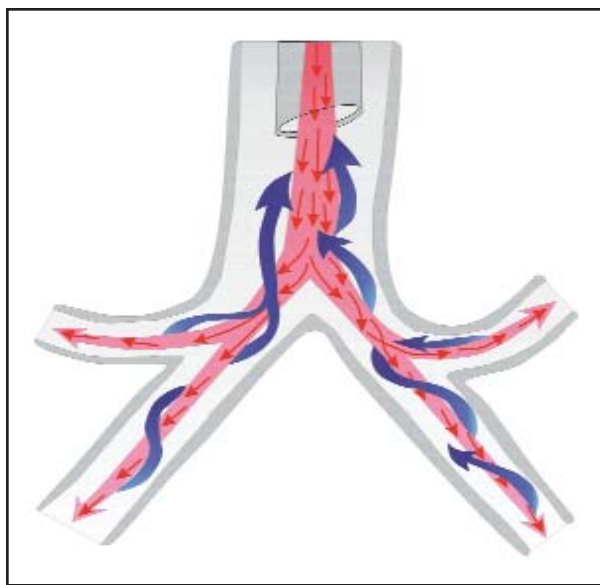
The Life Pulse has a set I-time, unlike HFOV where the I-

exhalation time (E-time). The Life Pulse I:E ratio varies from 1:3.5 at 660 bpm to 1:12 at 240 bpm. Giving patients more E-time is critical for patients with hyperinflation or excessive secretions. Trapped gas and secretions have a much better chance of moving up and out of the lungs with longer E-times achieved by lower rates.

Jet Nozzle:

A second key to understanding HFJV success is the jet nozzle built into the LifePort ETT adapter. Squirting gas into the

ET tube at high velocity allows gas to penetrate deeper into the lung with each breath, penetrating through dead space gas instead of pushing it ahead of the fresh gas. Delivering fresh gas in this way minimizes the size of each breath and pressure needed to deliver it to the aveoli. With fresh gas shooting down the center of the airways slower moving passive expiratory gas flow moves out along the airway walls. This countercurrent pattern facilitates airway clearance as shown in the following illustration.



Passive Exhalation:

The final key to understanding Life Pulse effectiveness is passive exhalation. In addition to enhancing airway clearance, passive exhalation allows the Life Pulse to run at a lower MAP compared to those used during high-frequency oscillatory ventilation (HFOV), because of its active exhalation.

MAP must be kept at a

high enough level during HFOV to keep the pressure generated during active exhalation from causing airways collapse. This is never an issue with passive exhalation. Therefore, the Life Pulse can usually provide adequate oxygenation at a lower MAP than HFOV.

Management Implications:

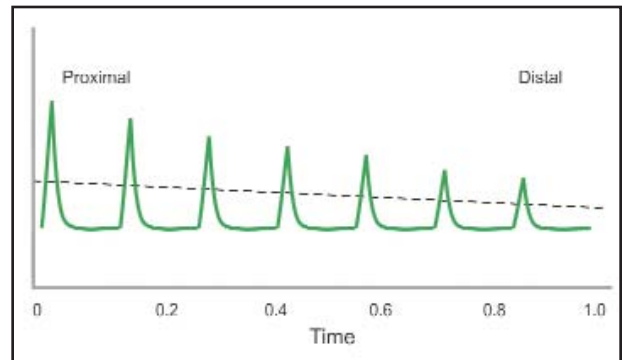
It is essential to stay focused on the primary control variables: MAP for oxygenation and pressure amplitude (PIP-PEEP) for ventilation. Once appropriate PEEP is set, HFJV PIP controls pressure amplitude and ventilation.

The MAP required for adequate oxygenation determines PEEP. There should be no pre-conceived maximum level of PEEP based on patient size.

Likewise, the pressure amplitude required for adequate ventilation determines HFJV PIP, and there should be no pre-conceived maximum PIP based on patient size.

PEEP controls mean airway pressure during HFJV, and MAP determines mean lung volume. Optimal PEEP/MAP facilitates oxygenation without the use of continual CV breaths. This

strategy relegates CV breaths to intermittent use for alveolar recruitment.



If HFJV rate is set low enough to avoid gas trapping and inadvertent PEEP, PEEP is constant down to the aveoli. However, HFJV PIP drops dramatically as its tiny tidal volumes approach the aveoli. So, there is little chance that HFJV breaths will over-expand aveoli.

Thus, the best approach for an infant with hyperinflated lungs is to eliminate delivery of all the bigger CV tidal volumes and extend the time for exhalation of the smaller HFJV tidal volumes by lowering HFJV rate. If problems are encountered using higher PEEPs on hemodynamically challenged patients, go back to using the Life Pulse with lower PEEP and intermittent CV “sigh” breaths to help keep the lungs open and improve cardiac function.

A solid understanding of how the Life Pulse works will help you discover the keys to superior patient management using HFJV. Remember:

* the very short I-time of HFJV results in tidal volumes

that are ~10 times smaller than those used during conventional ventilation, so higher PEEP levels can be used safely.

* I-time is set rather than being a percentage, so tidal volume does not change with changes in HFJV frequency.

* adjusting HFJV rate with its fixed I-time lets you control E-time and I:E ratio to address hyperinflation.

* finally, longer E-times and passive exhalation enhance airway clearance.

Keeping these concepts in mind as you use HFJV will guide you to patient management strategies that deliver the most effective and gentle ventilation possible.

iNO for PPHN - HFJV vs. HFOV

"Short Term Outcomes of Term and Near Term Neonates with Pulmonary Hypertension Treated with Inhaled Nitric Oxide (iNO) and High Frequency Oscillatory Ventilation (HFOV) Compared to iNO and High Frequency Jet Ventilation (HFJV)."

Eric Coates, MD presented his findings from this retrospective study conducted at Wake Forest University Baptist Medical Center at this year's Snowbird HFV conference. His conservative conclusion was, "short term outcomes of term and near term neonates with pulmonary hypertension treated with HFJV and iNO are at least as

good as those treated with HFOV and iNO."

This conclusion was conservative based on the two most significant findings in the study. The HFOV group was more likely to require ECMO [19/43 (44%) vs. 2/22 (9%): p=0.004] and there was a 12.5 fold greater risk of needing ECMO in patients that received HFOV/iNO compared to those that received HFJV/iNO [Odds ratio=12.5; 95% CI (1.4-108)], using a logistic regression model controlling for baseline severity of illness, the a/A oxygen ratio.

Sixty-five patients between April 1, 2000 and August 31, 2005 met the inclusion criteria: 35 weeks gestation, respiratory failure with clinical evidence of pulmonary hypertension, no congenital malformations, treatment with iNO in the first week of life in conjunction with HFJV or HFOV. Forty-three patients were treated with iNO and HFOV and 22 with iNO and HFJV. There were no demographic differences between the two groups.

This study is historic for two reasons. It is the first study ever to compare HFJV and HFOV in the same patient population. In addition, it is the first study to report on the clinical effectiveness of iNO delivery with HFJV compared to another mode of iNO delivery.

Dr. Coates has submitted this study for publication, but at this writing has not received a publication date. Copies of his abstract are available upon request by contacting Dave Platt at plattdr@bunl.com or 800.800.4358 ext. 15.

New additions to the Bunnell family ...

Bunnell is proud to introduce two new clinical specialists who have joined the Bunnell family: Keith Kohutek and Beverly Wainwright. Keith and Beverly were hired to meet the increasing training and support demands brought on by sales and Life Pulse use that have more than doubled over the last five years. Bunnell is committed to our customers and the service each of you receive. We are actively searching the north-east and the upper mid-west for outstanding candidates who will provide the level of expertise and service that you, our customers, have come to expect. If you know of anyone who would represent Bunnell and our products in an exemplary manner please contact Dave Platt 800.800.4358 ext. 15.

Please allow me to introduce ...

Keith Kohutek, BSRC, RRT-NPS joined Bunnell in June, 2006. Keith spent the last seven years as a staff therapist, lead therapist, and Day Shift Manager at Cook Children's Medical Center in Fort Worth, TX. During his

time at Cook, Keith worked as an educator and helped conduct many workshops, lectures, presentations, and in-services. Keith brings an



enthusiasm for teaching and a unique presentation style that we believe will benefit Bunnell customers for many years to come. Keith and his family (wife-Kristin, two girls-Katie and Amanda) moved to Salt Lake City, UT last June from Texas.

Keith provides training and sales support in Arizona, California, Idaho, Nevada, Oregon, Utah, and Washington. If you work in any of these states and have sales, training, or support needs, please contact Keith at 800-800-4358 ext. 35 or e-mail at keith.kohut@bunl.com.

Beverly Wainwright, RRT-NPS/RCP joined Bunnell in August, 2006. Beverly comes to Bunnell with 20 years experience as a respiratory therapist, primarily in the area of Pediatric/Neonatal Intensive Care. She spent the last three years as the Children's Hospital Clinical

Respiratory Specialist at Pitt County Memorial Hospital in Greenville, NC. Beverly has provided education in a variety of settings including groups and one-on-one training sessions with respiratory therapists, physicians, nurses, and nurse practitioners on a variety of Pediatric and Neonatal topics. Beverly lives in North Carolina with her husband, Mike, and son Justin.



Beverly provides training and sales support in North Carolina, South Carolina, Georgia, Florida, Tennessee, Mississippi, Alabama, Louisiana, and Arkansas. Please contact Beverly at 252-917-2101, or via email at beverly@bunl.com, for sales, training, or support needs.

Infant Star™ Trade-In Program

Bunnell Incorporated is offering a Trade-In Program for the Infant Star™ High-Frequency ventilator. A \$5000 credit can be applied toward the purchase of a Bunnell Life Pulse High-Frequency ventilator with the trade-in of a fully functioning Infant Star™

High-Frequency ventilator. This is a one-for-one, limited time offer!

Because of the huge trade-in discount being offered, rental credits may not be applied to the same purchase. The Infant Star trade-in program will be in effect until December 31, 2006.

To qualify for the Infant Star credit, the PO# and the Infant Star must be received by Bunnell Incorporated no later than Friday December 29, 2006 at 5:00 pm MT. Some restrictions may apply. For additional information contact Ken Hekking at 800.800.4358 ext. 13 or khekking@bunl.com.

Using a UPS with the Life Pulse

Many of you know that Bunnell has long recommended using an uninterruptible power supply (UPS) in conjunction with the Life Pulse. A UPS is a sophisticated power conditioner with a built-in battery. You may use one at home or in the office to protect your computer from power irregularities.

A UPS provides the same kind of protection for the Life Pulse. It regulates the power going to the Life Pulse so the microprocessor does not lock-up while the system is running on a patient.

Power fluctuations are more common in older hospitals and hospitals that are undergoing construction. They

can be the result of checking the hospitals back-up power system or electrical storms. Regardless of the cause, they have the potential to interrupt any microprocessor driven device.

Bunnell distributes one brand of UPS, which is made specifically for hospital use. There are a number of companies that make hospital grade UPSs. If you would like additional information about UPSs, contact our customer service department at 800.800.4358.

If you are running the Life Pulse, whether it's yours or a rental, we suggest you run it in conjunction with a UPS!

Jet Papers & Studies

Bunnell is always interested in case studies and research papers. If you have a study or paper you would like to share with other clinicians, we would like to help.

We are willing to help in the editing or proofing process, and can distribute copies of papers to other clinicians upon request. Articles and abstracts can be added to future newsletters. or be posted on our website.



The Snowbird Conference on High Frequency Ventilation

of Infants, Children & Adults, March 28-30, 2007 is also a great place to share your experiences with the Jet. Papers can be submitted to Don Null, MD at Primary Children's Medical Center, Salt Lake City, UT through the first part of January 2007.

Do you have a study in mind, but need help developing the protocol? If the protocol is not a problem, but support in the form of equipment or supplies is needed, whatever support you're looking for Bunnell can help.

If you want some assistance, or want to discuss ideas for a research project, contact Dave Platt at 800.800.4358 ext. 15 or plattdr@bunl.com.

PRN In-service Trainers Wanted

With the Life Pulse being used more than ever, requests for training has increased. Training clinicians is one of the most important services Bunnell provides. We are always looking for bright, enthusiastic respiratory therapists with "Jet" experience to add to our family of training specialists.

Training Specialists are used for in-service training, demos, evaluations, emergency clinical support and regional conferences. Bunnell provides extensive training and certifies respiratory therapists before utilizing them in the field.

Training Specialists must have the flexibility to travel. Trips are usually one to two days. Reimbursement is on a per diem basis with all expenses paid.

If you're looking for a new challenge and want to share your knowledge of the Life Pulse with other clinicians, contact Evan Richards at 800.800.4358. ext. 37 or evan@bunl.com.

Service Seminar 2007

The Bunnell Service Seminar is a technical service training program geared toward clinical engineers and biomedical technicians. The two-day seminar is held in Salt Lake City, Utah, in September each year. The program covers the theory of operation, clinical troubleshooting, bench top evaluation, and preventive 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-served 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 David Platt at 800-800-4358 ext.15 or plattdr@bunl.com.