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INSPIRED INFANT CARE

HOW to use the LifePulse HFV
Seven Steps to Success

LifePulse HFV clinical strategies have evolved from the accumulated experience of treating tens of thousands of infants as well as from randomized controlled studies. The following seven steps are a culmination of what Bunnell has learned over the past 23 years of clinical use.

1. **Start HFV ASAP**
   Many clinicians wait until an infant sustains significant lung injury before implementing HFV. Unfortunately, a failing respiratory system leads to failure of other organ systems, and once the patient reaches that point, chances for recovery are slim. The only significant difference between survivors and non-survivors in one LifePulse study was the time they spent on CMV prior to starting HFV (4 days vs. 10 days respectively). The sooner HFV is started, the better the patient's chance of recovery.

2. **Select Start-Up LifePulse Settings Based upon Patient Size and Pathophysiology**
   Monitor and record current CMV or HFOV settings using the LifePort ET tube adapter with the LifePulse in Standby mode.

   On-Time: the default On-Time (I-time) setting of 0.020 sec works best in most situations, so leave it set there.

   Rate: using 420 bpm usually works fine, for patients 2000 grams or less. Larger preemies, term infants, and infants with pulmonary hyperinflation, severe PIE, and other lung conditions where exhalation is compromised by airway inflammation or obstruction do better on lower rates. With I-time set at 0.02 sec., lower rates create longer exhalation times.

   The lowest LifePulse rate (240 bpm), where I:E = 1:12, is the best choice for pulmonary hyperinflation and severe PIE. Longer exhalation times facilitate diffusion of gas out of interstitial space, and allow hyperinflation to resolve. Minimizing the number and size of CMV breaths is critical in these patients.

   PIP: start LifePulse with PIP set 1-2 cmH_2O < the CMV or HFOV PIP monitored by the LifePulse. Press ENTER, verify the chest is vibrating, and adjust PIP as necessary to get appropriate $PaCO_2$.

3. **Maintain Pre-LifePulse MAP for Better Oxygenation at Start-Up**
   Focusing on MAP instead of PEEP reminds us what's most important for oxygenation. In general, you will use higher PEEP with the LifePulse to support MAP, which is safe because the LifePulse uses very small tidal volumes and a very short I-time (0.02 sec).

   Once you have started the LifePulse, reduce CMV support to 5 bpm and increase PEEP as needed to match the monitored pre-LifePulse MAP. [If you are switching from HFOV to HFJV, you can sometimes use less MAP (- 1 to 2 cm H_2O).] We will optimize PEEP in step 5.

4. **Fine-tune PIP to Manage $PaCO_2$**
   Use transcutaneous CO_2 monitoring and get a blood gas sample within 20 minutes of starting HFJV to see if PIP is adequate. Sometimes clinicians are surprised to see how much PIP it takes to ventilate premature infants. Remember: it is volume – not pressure – that creates lung injury, and the LifePulse uses extremely small tidal volumes (~ 1 mL/kg). HFV pressure amplitude decreases quickly as its tiny breaths approach the alveoli. So, raising PIP is the gentlest way to lower $PaCO_2$. A LifePulse V_T delivered with a PIP of 50 cm H_2O is still much smaller than a CMV V_T delivered with a PIP of 20 cm H_2O, due to the difference in I-times.

5. **Use CMV "Sigh" Breaths to Find Optimal PEEP**
   Sigh breaths are ***contraindicated*** in the presence of severe lung injury, and we can use the ***removal*** of the last 5 CMV bpm from step 3 to find optimal PEEP.

   Adjust FiO_2 to achieve the desired SaO_2 with the patient stabilized on the LifePulse with CMV at 5 bpm. Then switch CMV to CPAP mode and watch the pulse oximeter. If SaO_2 drops, increase PEEP 1-2 cm H_2O, re-institute the 5 bpm, and repeat the sequence. Once SaO_2 is stable with your CMV in CPAP mode, leave it in CPAP mode most of the time.

Switch CMV back to 5 bpm as needed to re-recruit collapsed alveoli after suctioning, etc., and whenever you want to test for adequate PEEP as just described. Moving CMV back to CPAP mode once oxygenation improves (after 15 minutes or so) will minimize the size and number of larger V_Ts delivered to the patient and help avoid "volutrauma."

If cardiac output suffers with higher PEEP, back off a little. Here you can use a few CMV sighs breaths per minute to compensate for inadequate MAP in the hope of improving venous return of blood to the heart. [Remember: it is O_2 delivery to the tissues that determines optimal PEEP.]

Some of the newest generation ventilators make it difficult to keep the CMV in CPAP mode with the LifePulse due to their apnea detection systems. With these ventilators, use the lowest IMV settings possible by minimizing rate, PIP, and I-time. Then turn up each setting as necessary when you want to provide effective sigh breaths.

6. **Be patient and use Servo Pressure, pulse oximetry, and transcutaneous CO_2 monitoring to stay on track**

   Recognize that weaning will only be possible when the patient's medical condition is improving. There is a time for initial stabilization of the patient, and a time for weaning. In between those times, focus on maintaining good blood gases and let HFJV "lung protective ventilation" facilitate healing and lung growth.

   Servo Pressure responds to changes in the patient's lung mechanics. Rising Servo Pressure is generally a good sign. Falling Servo Pressure may indicate deterioration and should be addressed quickly. Any time you get a Servo Pressure alarm you should investigate. Is the ETT poorly positioned or plugged? Is the patient's compliance getting worse? Or, is it just time to suction the airway?

   If monitored PEEP on the LifePulse is higher than set PEEP on the CMV, you have inadvertent PEEP, which will force Servo Pressure down and allow $PaCO_2$ to rise. Slow the LifePulse rate down in increments of ~60 bpm until the inadvertent PEEP goes away. Then manage $PaCO_2$ by adjusting HFV PIP as needed.

   If inadvertent PEEP is not present, you can increase LifePulse rate to lower $PaCO_2$ as you would with CMV. V_T is independent of rate with the LifePulse, so increasing rate increases minute ventilation and lowers $PaCO_2$.

   Fight PEEPaphobia! PEEP is the primary determinant of mean airway pressure and oxygenation (PaO_2). It also keeps airways open in older babies who get hyperinflated.

   When in doubt or whenever you need assistance with patient management strategies and troubleshooting, call the Bunnell Hotline (800-800-4358) for help. We are there for you 24 hours a day, 7 days a week.

7. **Wean Directly to Nasal CPAP**

   Once the patient has cleared his maintenance phase, weaning can begin. Our natural instinct is to wean patients from HFV back to CMV at the first signs of improvement. This approach may prolong your patient's time on mechanical ventilation at best. At worse, whatever condition caused you to go the HFV in the first place may reappear. Focus on maintaining lung protective ventilation all the way to CPAP.

   Wean PIP in response to improved $PaCO_2$. When PIP is below 20 cm H_2O, you can lower LifePulse rate to minimize interference with spontaneous breathing. At 240 bpm, I:E = 1:12; therefore, the patient is spending most of his time on CPAP already!

   Once the LifePulse PIP ≤ 16 cm H_2O, MAP < 8 cm H_2O, FiO_2 < 30%, and the baby is breathing regularly, you should consider transitioning to CPAP. A short trial of ET CPAP on the CMV will give you a good indication of how the patient will tolerate NCPAP.

   Don't worry about weaning PEEP too much. When you pull the ETT, match your NCPAP to the final LifePulse MAP. You can implement NCPAP at 8 cm H_2O if that is how much is needed, and your baby will breathe a lot easier without an ET tube.

Try these 7 steps to success on your next patient and let us know if they work for you. We are constantly seeking to improve our patient management strategies!