

REFLECTIONS ON HFOV

by John Salyer RRT-NPS, MBA, FAARC



In 1983 I attended my first real scientific conference on mechanically ventilating low birth weight infants. As conferences go, this one remains one of the more memorable that I have ever attended, and I have probably been to 75 since then. As I sat in the rather austere auditorium, I walked an unassuming man named Robert DeLemos, MD, who proceeded to explain to us the use of something he called a high frequency oscillatory ventilator. He took us on an amazing journey using data that he and others had developed studying mechanical ventilation of premature baboons at his research laboratory in San Antonio, Texas. I was stunned. This was my first exposure to the concept of high frequency ventilation.

As you might imagine, his ideas were controversial and not rapidly embraced by all the neonatal community. But his technology certainly seemed promising and I wondered how long it would be before it became widely available clinically. 23 years later, I wish I could tell you a happier story about high frequency oscillation in neonates, but I cannot. From my perspective the use of the device is still very heterogeneous across the neonatal community. The use of HFOV has devolved into camps, which I will call the early intervention camp, the rescue camp and the late rescue camp. There are NICU's where HFOV is widely used as an early intervention device, e.g. all or nearly all premies requiring mechanical ventilation are placed on the HFOV after intubation and remain for all of their ventilator course.

There are also NICU's where most of these same types of infants would instead receive conventional mechanical ventila-

tion (CMV), going onto HFOV only if they fail CMV or require high enough settings on the ventilator that clinicians are worried about the risk of ventilator induced lung injury (the rescue camp).

Then there are those NICU's where the HFOV would only be used as an absolute last resort, when refractory hypoxemia and or respiratory acidosis are an immediate threat to the patient's life (the late rescue camp).

A very good therapist who works for me once formally emailed the Medical Director of the NICU, describing his frustrations over why we couldn't seem to get more infants on HFOV sooner, and why there was so much variation in the willingness of some neonatologists to use the HFOV device early or at all.

His question was well timed, since just a few months before, an issue of the New England Journal of Medicine had contained two large randomized trials of HFOV versus CMV in neonates and the papers had very different conclusions. One paper suggested that HFOV and CMV did produce different outcomes and the other suggested that HFOV produced small but significantly improvements in pulmonary outcomes.

No wonder there is such wide variation in practice. The literature on HFOV in neonates wanders all over the place. There are randomized clinical trials of CMV versus HFOV that show the following; (1) no difference in outcomes, (2) HFOV is superior to CMV, (3) CMV is superior to HFOV. Follow up studies of CMV versus HFOV have shown that: (1) testing of infants after the neonatal period shows no difference in pulmonary function, (2) testing of infants after the neonatal period shows that HFOV is superior to CMV.

Meta-analysis is the practice of combining results from lots of studies and trying to summarize all the best literature on a given topic. HFOV versus CMV has been subjected to several meta-analysis. Most of these studies indicate that HFOV produces no better outcomes than CMV and even those that show a benefit, show only a modest benefit at best. The best meta-analysis I have found is by Bollen et al. These investigators stratified the studies according to the ventilation strategies used. Those interested in really understanding this complex topic are urged to read Bollen et al, as well as the work of Froese and Kinsella.

It is beyond the scope of this column to carefully review the strengths and weaknesses of these various studies. Clearly some investigators are able to produce better outcomes with HFOV while others are not. My view is that there are two principal reasons why these differences are evident.


One factor is how the HFOV is used. There are very specific strategies for using the HFOV in different disease states. Ventilator strategy must be driven by patient pathophysiology. While this seems obvious, this has been a difficult transition for some parts of the community to make, especially since HFOV requires the clinicians to think in a different fashion about mechanical ventilation. There has also been considerable evolution in how CMV is done. I believe some of the studies lacked sufficient control, e.g. design rigor, for how CMV and HFOV was carried out. What happens is this; optimal HFOV may be compared to less than

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optimal CMV, or conversely optimal CMV may be compared to sub-optimal HFOV. This would explain the apparent variation in findings in studies that appear to be similarly designed.

Another concern I have about HFOV is how it is being spread in the neonatal community. The use of these devices requires a lot of training, of all clinical disciplines. I have seen well-intentioned departments underestimate the magnitude of training required. I also believe there has been a lack of medical leadership about this in some circles. I think there is sometimes insufficient training of medical staffs. The scenario goes like this. Some doctors who were trained at a center that was excellent at HFOV join another neonatal practice group that does not do HFOV. They convince the hospital to buy HFOV ventilators. The RT department starts trying implement the use of the devices, including lots of required training for RT's and nurses, but sometimes the training of all physicians in the practice group is not mandatory. Thus, some physicians rotate onto service that neither understand the device nor are very convinced of its efficacy. Thus, the implementation is slowed or even halted. HFOV is a complex operation in some ways and doing it infrequently does not then generate enough skill on the RT and medical staffs to ensure competency. Thus, when someone does want to use the ventilator, there is a potential for increasing risk to patients, owing to misadventures of misapplication. Anyone wishing to start a HFOV program or expand an existing one is advised to spend a lot of time carefully planning training and competency assessment of all clinical disciplines, to minimize patient risk for in spite of these obstacles, and the sometimes confusing literature on HFOV, it can clearly be an important tool in the management of neonates with respiratory failure.

Inhaled Respiratory Medications... Continued from previous page

hospitals, SNF, long-term care facility and home. The most commonly delivered medications include the beta-agonist bronchodilators, many of which are used as rescue inhalers: albuterol sulfate (generic), Proventil (albuterol sulfate), Ventolin (albuterol sulfate), Xopenex (levalbuterol sulfate) available in 0.63 mg and 1.25 mg strengths, Alupent (metaproterenol sulfate), AsthmaNefrin, MicroNefrin or VapoNefrin (racemic epinephrine) and Formoterol fumarate (generic – available as a compound). The anticholinergic bronchodilators include: Atropine sulfate (generic), Ipratropium bromide (generic), Atrovent (ipratropium bromide) and DuoNeb (albuterol sulfate and ipratropium bromide) – both beta-agonist and anticholinergic classes of bronchodilators.

ICSs that can be nebulized are Pulmicort Respules (budesonide) and Budesonide (generic – available as a compound).

Non-steroidal maintenance of asthma is available for nebulization as Intal (cromolyn sodium) and Cromolyn sodium.

Mucolytic and proteolytic agents can also be nebulized and include: Mucomyst and Mucosil (n-acetylcysteine) in 10% and 20% strengths and Pulmozyme (dornase alfa).

Anti-infective or antimicrobial agents available in solution for nebulization include: Tobramycin, Nebupent and Pentam 300 (pentamidine isethionate) and Colistin and ColyMycin (colistimethate sodium).

The number of inhaled respiratory medications will most likely increase in the years to come as the incidence of chronic lung diseases increase. On the horizon, are inhaled medications such as insulin and pain relievers that will add to the importance of aerosol therapy and the RTs involved.