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Notes from the Chair

by Timothy R. Myers, BS, RRT

Now that summer is here, those of us working in children's hospitals across the country are entering what is frequently called the "trauma season." The kids are out of school, the weather is nice and warm, physical activities and car trips are increasing, and our beds are, unfortunately, filling up with accident victims and near drownings. Since school is out, surgical activity is on the rise as well. But despite these busy times, I need to remind you of two very important items that we will need to address prior to the publication of the next Bulletin: the selection of a new Neonatal-Pediatric Section Chair and Specialty Practitioner of the Year (SPOY).

The AARC will be sending out ballots for the chair election in the next several months. Two former SPOY winners, Melissa Brown, from California, and Michael Tracy, from Ohio, will be on the ballot. The winner of this section-only election will serve one year as chair-elect (2004) and then a three-year term as chair (2005-07). If our section still has 1,000 or more members on December 31, the new chair will also serve on the AARC Board of Directors. As the last U.S. presidential election demonstrated, every vote counts, so please remember to cast your vote for one of the two candidates.

As many of you are aware, every year each of the AARC Specialty Sections presents a Specialty Practitioner of the Year award to a deserving member at the Awards Ceremony during the AARC International Respiratory Congress this year in Las Vegas, NV, December 8-10, 2003). As the nomination deadline approaches, I encourage all members to start brainstorming names of worthy candidates and preparing nominations for submission. The easiest way to nominate a peer for this award is through the Neonatal-Pediatric Section

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HFOV in the NICU: An Update

by Michael Tracy, RRT

True or False: HFOV reduces the incidence of air leak and cerebral bleeding in pret VLBW infants in the NICU.

Before you jump on your buzzer, let's look at the literature and see what objective there is to support your "true" or "false" answers.

In 2002 the Cochrane Database of Systematic Reviews, based at the University of Sy in Australia, did a meta analysis of all the studies pertaining to premies and HFOV i NICU. Their stated objective was to "determine whether the elective use of HFOV as c pared to CMV in preterm infants who are mechanically ventilated for RDS decrease incidence of CLD without adverse side effects"[1]

The Cochrane group found eight studies eligible for their meta analysis.

The first study was the HIFI[2] study published in 1989, which enrolled 673 infants we ing 750-2000 grams. Study protocol dictated the same P_{aw} for the HFOV arm as the pat had been on for their CMV period, or started the P_{aw} at 8-10 cm H_2O if they went stra to HFOV. Enrollment was stopped at an interim analysis because there was no differ between the CMV and HFOV groups in the incidence of BPD. Additionally, the H group trended toward a higher incidence of air leak. The rate of significant [grade III & intraventricular hemorrhage (IVH)] and periventricular leukomalacia cerebral bleeds significantly higher in the HFOV group. This study has been criticized because it did include methods to recruit lung volume.

The Provo Multicenter Trial enrolled 125 patients. The study protocol started the H group P_{aw} 1-2 cm H_2O higher than the P_{aw} on their CMV. Surfactant was administ while the patients were on CMV. This study concluded that when used early with a recruitment strategy, HFOV after surfactant replacement therapy resulted in outcomes sistent with a reduction in both acute and chronic lung injury. Two other noteworthy c ments in this paper: (1) routine suctioning (Q4) was discouraged to prevent volume while the CMV group required more frequent suctioning and (2) this is the only study states that early HFOV may result in decreased health care costs. This study has also criticized because it used IMV fx = 30 requiring higher PIP. Criticism has also suggested the patients were not as sick and were of an older gestational age.

In 1992 Clark[4] enrolled 83 patients in a study that also included a lung recruitment s egy of increasing the HFOV P_{aw} 1-2 cm H_2O above the CMV P_{aw}. Surfactant replacer therapy came into existence while this study was in progress, so it was not included i study protocol. Patients assigned to the HFOV-only arm of the study had the lowest dence of CLD. Clark et al found no significant differences between the groups in the dence of PIE, pneumothorax, or IVH. One noteworthy segment of the paper states, "Bec of logistic factors, the time of initiation of HFOV (mean 8 hrs) was comparable with used in the baboon HFOV 'rescue' trial. Therefore the clinical response would not be as matic as that seen with the immediate institution of HFOV. These observations suppor hypothesis that the pattern of lung injury characteristics of hyaline membrane disease oc within a few hours of initiation of assisted ventilation and that optimal therapy would rec intervention at the time of birth." Clark comments that Lee and O'Brodovich[5] suggest "when collapsed units are reopened, airway epithelial surfaces that were adherent to other are injured. Protein leaks from those injured areas and inhibits the effectivenes surfactant. A cycle can develop whereby injury necessitates the use of higher ai pressure excursions which produces more injury."

In 1999 Thome[6] et al enrolled 284 patients (>24 and <30 weeks gestational age) in a that utilized a high volume strategy (HVS) where the P_{aw} was 1-2 cm H_2O above the C

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P_{aw}. This trial is noteworthy because it utilized the Star 950 HFFI. This study was stopped at an interim analysis point because there was no difference between the HFOV and CMV groups, with a trend toward more lung injury in the HFOV group. Data analysis said that the trend toward treatment failure in the HFOV group was solely contributable to air leak. No difference was found in the frequency of cerebral bleed in the two groups. HFOV was started within one hour of intubation. This study also utilized a sustained inflation maneuver after suctioning. Similar numbers of patients in both the HFOV and CMV groups received surfactant. The authors were certain that surfactant was not a confounding factor. Thome et al were the researchers criticizing the Provo Multicenter trial for their choice of rate (<30) and higher PIPs. Thome et al close by quoting an A.H. Jobe[7] editorial, "HFV may not be better than optimal IPPV with a sufficient PEEP to achieve good FRC, low tidal volumes, and P_{CO_2} targets that minimize hyperventilation. How well a mode is performed seems to be more important than which mode is chosen."

Moriette[8] et al (2001) enrolled 273 patients (24-29 weeks gestation) using a lung recruitment strategy and surfactant. Initial HFOV P_{aw} was set at 14 cm H_2O if the F_{IO_2} > 0.40 and 2 cm H_2O above the CMV Paw if the F_{IO_2} < 0.40. Further optimization of the lung was done using sigh breaths (T_i <1) with a pressureof 4 cm H_2O greater than the P_{aw}. Improved oxygenation after the sigh breaths resulted in increasing the P_{aw} x of 2 cm H_2O. If the F_{IO_2} >0.40, P_{aw} was increased to 16, and as much as 18 cm H_2O. The CMV arm was also evaluated to allow increases in P_{aw}.

Moriette et al concluded that, "HFOV in very premature infants decreases exogenous surfactant requirements, does not improve the pulmonary outcome and may be associated with an increased incidence of severe IVH. Exogenous surfactant is the undisputed first-line treatment of respiratory distress syndrome.

Plavka[9] enrolled 37 patients (<31 weeks, 500-1499 g) in a study design similar to that of the Provo Multicenter Trial. The main differences were the start of the randomized ventilator method within 20 minutes, use of surfactant after defined criteria were met, and a significantly younger study population. Study design optimized lung volume by increasing HFOV P_{aw} 30% above that of CMV to obtain a CXR with nine ribs expanded. The study concludes that, "HFOV applied early and when the clinical strategy of maintenance of optimal lung volume is used, improves oxygenation in the acute stage of RDS, reduces the need for surfactant and can decrease the injury to lung tissue even in extremely immature newborns." No differences were found in the two arms for air leak or central nervous system morbidity. Antenatal steroids were given to mothers with signs of premature labor or with premature rupture of membranes at <32 weeks gestation. Approximately 50% of each group received steroids

Rettwitz-Volk W et al[10] enrolled 96 patients (gestation <32 weeks, 1/3 patients <1 Kg equally divided in the two arms of the study). P_{aw} and (P were set to show good chest movement. Entry to the study arm was 40 ±20 min for CMV and 70 ±30 min for HFOV. Their conclusion was that after surfactant therapy, HFOV as a primary mode of ventilation in premature infants with RDS is as safe and efficacious as CMV. Each group had similar numbers of air leaks and cerebral vascular hemorrhage.

Ogawa[11] enrolled 92 patients in a multicenter trial. Patients weighed from 750 to 2000 grams. Patients were entered into their treatment arm by 60 minutes if they were inborn and six hours if they were outborn. In the HFOV group, lung volume was recruited by manual ventilation just before starting, and a high mean airway pressure was adopted. Surfactant replacement therapy was used in this study when an RDS diagnosis was made.

This study found no significant differences in the incidence of air leak, pulmonary hemorrhage, IVH, pneumonia, or symptomatic PDA between the CMV and the HFOV arms of the study. Patients receiving supplemental oxygen or mechanical ventilation at 28 days were not statistically different in the two groups.

This study was designed to reevaluate the results of the HIFI study and observe the major complications reported to be higher in HFOV. The authors write, "In this trial mean airway pressure was significantly higher (the HIFI study kept mean airway pressure the same in both arms) to attain lung volume recruitment."

The study conclusion was, "HFOV improves oxygenation in preterm newborn infants with respiratory failure but does not increase the risk of complications when used by expe-

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rienced neonatologists."

What does all this mean, when taken as a larger whole in the Cochran meta analysis?

- There is no difference in mortality between CMV and HFOV in the preterm infant.
- There is a significant reduction in the risk of CLD in three trials where an HVS is used.
- Six trials report air leak. Gross pulmonary air leak, excluding PIE alone, is reported in 759 infants in five trials. In four trials using HVS there is a trend towards an increase in gross pulmonary air leak in the HFOV group.
- The rates of the more severe grade III or IV IVH are increased in the HFOV group.

The overall conclusion of the meta analysis?

"Benefits of HFOV in terms of CLD appear to be outweighed by concerns about increased rates of pulmonary air leak and severe IVH. Until these issues are resolved HFOV cannot be recommended as the routine method of giving mechanical ventilation to preterm infants with RDS."

Now which answer did you buzz in on?

After the Cochrane meta analysis was published in 2002, two additional studies and an editorial were published in the *New England Journal of Medicine*. Courtney[11] et al enrolled 500 infants (601-1200 gms) where "strategies for ventilation for both groups emphasized lung recruitment and avoidance of atelectasis and over distension with ideal lung expansion defined as expansion to 8.5 to 9.5 ribs for most infants but 7-8 ribs for infants with air leak or CLD." Initial P_{aw} was at least two times higher than on CMV. The CMV arm used V_t from 4-7 mL/Kg, with 5-6 mL/Kg preferred. PEEP was 4- 6 cm H_2O. All infants were treated with surfactant before entering the study.

No significant differences in the incidence of IVH or pneumothorax was found in either group. Pulmonary hemorrhage was less likely to develop and PIE was slightly more likely to develop in the HFOV group. They concluded, "There was a small (47% vs 56%) but significant benefit in terms of pulmonary outcome for VLBW infants without an increase in the occurrence of other complications of premature birth."

The UKOS group[13] trial (797 patients, 23-28 weeks) enrolled their HFOV arm to begin P_{aw} at 6-8 cm H_2O and increased by 0.5 to 1.0 cm H_2O Q 10-15 min until it was possible to decrease the FIO2. Nine ribs was optimal inflation. Infants received surfactant as soon as possible after birth. The primary outcome was death or chronic lung disease. Forty-one percent of each group had CLD and almost identical death rates (25% CMV, 26% HFOV). They concluded that CMV and HFOV do not differ in the early treatment of respiratory disease in VLBW infants.

Ann Stark[14] wrote an editorial stating that, In 4 of 5 trials since surfactant replacement became available for the treatment of RDS, the choice of the mode of ventilation made no difference in the rate of survival without BPD. The one trial in which HFOV reduced the rate of BPD included few high risk patients and used relatively high vent pressures with CMV (The Provo Multicenter Trial)…Furthermore, in inexperienced hands, HFOV may confer additional risks for individual infants, including inadvertent over distension of the lungs, impaired cardiac output, and increased CVP that might lead to intracranial hemorrhage … HFOV [should be] used in the most experienced centers. However, for most preterm infants, CMV with low tidal volumes and reasonable ventilation goals remain the appropriate choice.

AUTHOR'S NOTE: Many thanks to Dr. A. Fanaroff and Dr. R. Rodriguez for helping me collect and understand these papers. Most importantly, I thank them for helping me see beyond my personal bias.

EDITOR'S NOTE: For a complete list of references used in this article, visit the section homepage on www.aarc.org ◆

Notes from the Co-Editor

by Melissa K. Brown, RRT-NPS

In this Bulletin, you'll find an excellent review artic Michael Tracy examining many of the studies publishe HFOV in the neonate, a topic interesting to our profes on several levels. Despite this modern era of evide based medicine, HFOV became a widely accepted the before there was scientific evidence of its clinical value safety, for that matter. Indeed, the ten studies used fo most recent Cochrane review were spread over 18 yea period of time when obstetrics and neonatal pra changed dramatically. The widespread use of intrapa steroids and post-natal surfactant dramatically altered clinical course of premature neonates. The early trials treating patients up to 34 weeks gestation and 2000 gr Recent trials investigated HFOV in neonates less tha weeks and under 1200 grams. What's more, interventio these studies were highly varied and featured different tilators - not only different control ventilator types modes, but also different high frequency ventilators. O ten trials in the review, four utilized the Sensorme 3100a, one used the Infant Star 950, two used Hummingbird, one used a French piston ventilator, and used a variety. To top it all off, blinding was not possib any of the studies, because as we all know, everyone ca when a patient is on HFOV.

The NICU has a strong history of embracing thera without evidence. For example, steroids to reduce venti days, hyperventilation for PPHN, and high-flow nasal nulae for nasal CPAP. Adding to the irony is the historic icence of neonatologists to embrace new mechanical v lation modes. How did HFOV become so entrenched? guess is that it just made sense to most physicians that s tidal volumes would be better for our patients. Or, the c panies that developed HFOV did a great job of selling us. (Food for thought: someone said to me recently tha ventilator modes we use today in the ICU are the d result of the salesmanship and marketing abilities of viduals and companies.)

This is an interesting time for facilities that utilize H in the NICU. Here in San Diego, the discontinuatio the Infant Star ventilator is causing great discus What will we use in its place for HFOV? Will we purc more Sensormedics 3100as? Will we re-embrace high quency conventional ventilation with small tidal volum a comparable therapy, as A. H. Jobe suggests? I ten agree with Dr. Thome: it is most important to do what know and do it well. This emphasizes the need for all c cians, especially respiratory therapists, to be sk clinicians and consultants, as well as skeptics and, importantly, researchers! ◆