Diagnostics Bulletin

THE AMERICAN ASSOCIATION FOR RESPIRATORY CARE

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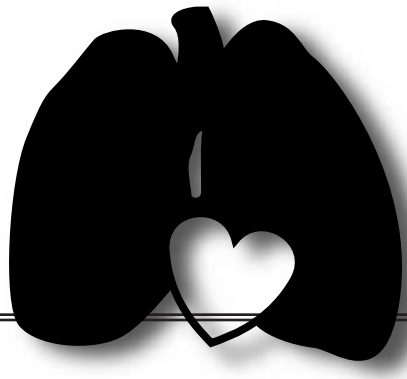

NOTES FROM THE CHAIR

by Susan Blonshine, BS, RRT, RPFT

You must give time to your fellow man—even if it's a little thing, do something for others—something for which you get no pay but the privilege of doing it.

—Albert Schweitzer

As we enter a new year, we continue to be surrounded by constant reminders of our changing healthcare environment. Medicare, for example, recently released new guidelines for pulmonary function testing reimbursement (they can be found in the Medicare newsletter dated 11-12-96) and HCFA and the NHLBI just announced the sites for the long-awaited lung volume reduction surgery study. (See the "FYI" section of this issue for more on that.)

But amid all the new developments in technology, changing rules on reimbursement, downsizing, and re-engineering that are out there, one constant remains. That constant is the compassion that we share with each patient who enters our care. Regardless of what else happens, the one thing that must not change is the caring.

This applies to our professional activities as well. It is a privilege to begin another year working with the dedicated members of the Diagnostics Section. I would encourage each of you to seriously consider what you can do to improve patient care through mentoring a colleague, writing an article for the *Bulletin*, or supporting diagnostics at the affiliate level. It is through the efforts of many that we will continue to learn and grow professionally.

Of course, communication holds the key to our success and we want you to let us know if the section is meeting the needs of the membership. One new way you can do that is by keeping an eye on the AARC's homepage on the Internet (http://www.aarc.org). As the site develops, we will have the opportunity to provide online information directly to the members of our section. Are there specific items that you would like to see online? If so, I can be reached by e-mail at the address listed on the back page of this and every issue.

This issue of the *Bulletin* features several articles about the expanding role that RCPs are playing in the diagnostics field. We need to continue addressing cross-disciplinary training. What education, training, knowledge, and skill sets do we already possess? What can we learn to expand our scope of practice? It is important that we ask and measure the responses to these questions. We must be attentive to the value of RCPs in diagnostics, as well as to the intertwining of diagnostics in other care sites. Be aware of the other health care professionals and the value they bring to each setting. It is through this understanding of the value of each health care provider that we can effectively collaborate in the provision of value-driven care.

This issue also contains two case studies on unusual, but important, findings of exercise testing with gas analysis and arterial blood gases, along with a summary of the minutes from our section business meeting held in San Diego during the AARC Convention last fall. As you can see from Carl Mottram's report, the section is engaged in a number of important activities that will require support from the membership.

Finally, please take a few moments out of your day to nominate a deserving colleague for our "Quarterly Practitioner of the Year." It should be a privilege for each of us to honor a colleague who goes that extra mile for his/her patients and profession.

NOTES FROM THE CHAIR-ELECT: *THE ANNUAL BUSINESS MEETING*

by Carl D. Mottram, RRT, RPFT

The annual section business meeting, which was held during the AARC Convention in San Diego, kicked off with a visit from AARC Associate Executive Director Sherry Milligan, who spoke to the group about the video conference services offered by the AARC and surveyed those in attendance as to why they had joined the section. Members cited the quality of information in the Section *Bulletin* and the section's resource network as major benefits.

Following Sherry's presentation, our section chair, Sue Blonshine, discussed the section's agenda for the coming year. Strengthening communication within the section was at the top of the list and several programs were slated for evaluation, including the development of state diagnostics sections and state resource directories. Nationally, the section will continue to strive for excellence in the *Bulletin* by enhancing content and increasing participation in producing that content among the membership. *Bulletin* Editor Catherine Foss got the ball rolling by soliciting topics for upcoming issues from those in attendance and asking members to recommend authors to write on the subjects they suggested.

Among the topics that will be addressed during the coming year are diagnostics in the areas of pulmonary, cardiac, clinical laboratory, and sleep. Restructuring, legislative and regulatory issues, career ladders, and benchmarking will be included as well. Cathy also noted that, beginning in this issue, the *Bulletin* will feature a new column called "Spotlight Corner." This section will highlight laboratories that are initiating or participating in new or innovative programs.

As the meeting continued, Sue emphasized the importance of developing our section leadership through the mentor process and recommended that everyone participate in the resource directory either as a source or as a user. (See the sign-up form in this issue.) She then updated members on the AARC's diagnostics-related Clinical Practice Guidelines (CPGs) and introduced Robert Brown, past section chair, who was recently approved by the AARC's Board of Directors as the new Chair of the Diagnostic CPG Committee.

Bob told the group that the committee planned to have the update of the Diffusing Capacity CPG available for peer review by February 1997 and expected to finish the Cardiopulmonary Exercise Testing CPG within the next 12 months as well. Sue encouraged everyone not already a member of the Diagnostic Peer Review Network to call the AARC office and participate in the review process, emphasizing that the impact that our CPGs have in Washington

D.C. and elsewhere depends largely on the number of working practitioners who sign off on them via the review process.

From there, Sue informed the group about the section's active role in the National Committee for Clinical Laboratory Standards (NCCLS). She has been serving as the AARC's liaison to the NCCLS and Bob Brown will participate in the Committee's efforts to write a procedure for pulse oximetry. In addition, the AARC will send a representative to the NCCLS consensus conference on managed care scheduled for April 18-20. This relationship with the NCCLS, says Sue, is important to the section and has been developing over the last few years.

An update on the AARC's Uniform Reporting Manual (URM) revision was next on the agenda. Sue emphasized to the group that the revision is a major project that addresses the need for consistency in describing, reporting, and developing time standards for the tests we perform. The AARC leadership, she says, is assisting the ad hoc committee overseeing this effort in developing a survey tool that will aid the group in collecting good cross-sectional data for this manual. The time frame of completion should be within the next year.

Sue then reviewed the proposed topics for the 1997 Convention and asked for input from the group as to what needs to be addressed and how topics should be prioritized. Specific suggestions included the RCP's role during clinical laboratory testing (e.g. glucose, electrolytes, lactate, etc.) She also noted that 1997 marks the first time that the AARC would be asking the general membership for suggestions regarding meeting topics and applauded the AARC's commitment to expanding the sphere of influence within the association.

Sue ended her presentation by discussing other membership issues, including the need for outcomes data justifying pulmonary diagnostic testing, information that she says will be essential in the managed-care environment. John Hannigan then spoke briefly to the group regarding the sharing of information through the Internet via "RC World" and Steve Nelson thanked the manufacturers present for their interest in attending the meeting. Sue echoed those sentiments, noting that only by partnering with manufacturing can we serve the needs of our physicians and patients.

PULMONARY EXERCISE TESTING AS PART OF THE EVALUATION FOR METABOLIC AND MITOCHONDRIAL MYOPATHIES

by John J. Wald, MD

John Wald is in the department of neurology at the University of Michigan Medical Center in Ann Arbor, MI.

Pulmonary function and exercise testing is routinely used in evaluation of ventilatory and cardiac function. Decreased inspiratory and expiratory pressures (P_{Imax}, P_{emax}), decreased transdiaphragmatic pressures, and restrictive patterns on PFTs all suggest underlying ventilatory muscle weakness which may be part of a diffuse myopathy or limited to the muscles taking part in ventilation. When considering a diffuse myopathy, specifically metabolic or mitochondrial myopathies, exercise testing can provide measurements of metabolic function and peripheral oxygen utilization that may aid in reaching the appropriate diagnosis.

Metabolic muscle disorders (myopathies) are suspected when patients develop weakness, most often when there is superimposed exertional myalgia (the premature sensation that the muscle is "burning," as with over-exertion). The burning discomfort is likely produced by the rapid build-up of lactic acid after early failure of oxidative metabolism causes a shift to anaerobic metabolism. The weakness is related to the lack of available energy required for muscle contraction. This is a result of diminished ability to metabolize carbohydrates or lipids, or decreased capacity of the mitochondria to convert carbohydrate and lipid end-products into adenosine triphosphate (ATP).

The mitochondria produce ATP using their "respiratory chain," passing electrons from one component to another, a process that consumes a great deal of oxygen, producing H_2O, CO_2 and energy (ATP). As energy production requires both breakdown of substrate into basic components and oxidative metabolism of these components into CO_2, most of the metabolic and mitochondrial muscle disorders produce similar clinical findings and similar abnormal results during exercise testing. Because of these similarities, metabolic and mitochondrial myopathies will be grouped together as "metabolic myopathies" for the remainder of this discussion.

Determination of decreased respiratory chain oxygen utilization and early shift to anaerobic metabolism are important factors supporting the diagnosis of metabolic myopathy. As such, when a metabolic myopathy is suspected, the neuromuscular disease specialist may request pulmonary exercise testing to evaluate these parameters. This is accomplished by a number of measurements obtained during exercise testing, including work produced during the test, changes in venous lactic acid, and expired O_2 and CO_2.

Some of the most important parameters obtained during exercise testing are the comparisons of heart rate or cardiac output, lactic acid, and ventilation to oxygen consumption (determined from the differences in inspired (room air) and expired O_2 and differences in arterial and venous O_2) or work produced. Excessive "hyper-dynamic" cardiac output suggests diminished uptake and utilization of oxygen by diseased mitochondria or lack of substrate for the mitochondria to metabolize, resulting in a reduced oxygen requirement.

Another metabolic component that can be determined is the "anaerobic threshold" (AT), the point at which metabolism shifts from efficient, oxygen requiring "oxidative" metabolism to less efficient "anaerobic" metabolism. When anaerobic metabolism is prematurely required, diminished capacity for aerobic metabolism (through the Krebs or tricarboxylic acid cycle) or mitochondrial respiratory chain dysfunction is suggested. At the onset of anaerobic metabolism lactic acid production increases. This can be easily determined by comparing lactic acid levels to pre-exercise baseline levels. In fact, the measure of oxygen uptake (measured in L/min) at which point lactic acid production increases is one measure of underlying aerobic fitness.

As oxygen utilization depends on the delivery of oxygen to the mitochondria, reduced delivery due to underlying cardiac or pulmonary limitation may produce very similar results. Correct interpretation of pulmonary exercise testing requires knowledge of the subject's cardiopulmonary status.

Currently, therapies for the metabolic myopathies are quite limited. There have been suggestions that vitamins (e.g., riboflavin, ascorbic acid), co-factors (e.g., co-enzyme Q10), and supplements (e.g., carnitine) may improve metabolic function in some, but certainly not all, patients with these conditions. The response is not even consistent for specific disorders. For example, only a portion of the patients with mitochondrial disorders respond to currently available treatments, and, unfortunately, most of the myopathies related to defective carbohydrate metabolism do not respond to any therapy. Serial measurement of O_2 utilization and AT can provide objective evidence of any beneficial effects from these compounds, and can also allow tracking of disease progression.

The following brief case summaries show how pulmonary exercise testing can be useful in diagnosing patients with metabolic and mitochondrial myopathies—

Case 1 involved a 29-year-old female runner and body builder who noted rapidly progressive dyspnea, muscle weakness, and fatigue. Over one month her strength declined to the point where

she was unable to climb one flight of stairs, and dyspnea limited walking to approximately 10 meters before requiring a rest break. Initial PFTs revealed an FVC of three liters (72% predicted), and exercise testing revealed oxygen consumption of 64% of predicted. The anaerobic threshold was reached at less than 50% maximal predicted oxygen consumption, quite low for someone of her fitness level.

Cardiac evaluation with echocardiogram was normal. On the basis of the clinical history and exercise tests, a muscle biopsy was performed, revealing abnormalities of lipid metabolism (accumulation of lipid in the muscle cells and low intra-muscular carnitine, a co-factor in lipid metabolism required to get the lipid into the mitochondria where it is metabolized) and markedly reduced mitochondrial oxidative function. Supplementation with co-enzyme Q10 and carnitine lead to dramatic improvement in function, normalization of strength, and improvement in FVC to 4.1 liters (104% of predicted). This improvement persists to date, nearly two years since initial diagnosis.

Case 2 involved a 28-year-old man who was evaluated for lifelong spells of unconsciousness after exertion thought to be a seizure disorder. Strength was normal, but unconsciousness and marked tachycardia and tachypnea (with gradual return to normal consciousness over 15 minutes) could be readily reproduced by climbing two flights of stairs. During minimal aerobic exercise, lactic acid increased from 1 to 15 mEq/L (normal range 0.5 to 2, even during light exercise). Further extensive evaluation revealed markedly abnormal mitochondrial accumulations with abnormal mitochondrial inclusions but normal enzymatic function. Trials of available treatments have lead to no improvement to date.

The neuromuscular specialist, while of course interested in cardiac and pulmonary functions, most often uses pulmonary exercise testing to establish abnormalities in underlying metabolism that will suggest a diagnosis of metabolic muscle disease. This often is very helpful in determining further patient evaluations (e.g., muscle biopsy with biochemical testing) and treatment. As potential new therapies become available, pulmonary exercise testing will be one means of objectively determining their effectiveness.

PHRENIC NERVE STIMULATIONS IN THE PULMONARY LAB

by Catherine M. Foss, BS, RRT, RPFT

Since many neuromuscular diseases can have an effect on respiratory function, it is only logical to combine some forms of neurological testing with pulmonary testing. Patients are referred to the pulmonary laboratory at the University of Michigan for evaluation of suspected diaphragm dysfunction or neuromuscular weakness.

The patient arrives after being NPO for a minimum of 6 hours. Pulmonary function tests including spirometry, lung volumes, and MVV, are performed. The patient signs an informed consent, and is questioned as to the presence of any implanted devices such as pacemakers or defibrillators, then testing progresses to the more invasive. The patient's neck and chest are rubbed with alcohol to remove skin oils. Chest hair is shaved, if necessary, to place electrodes. Surface electrodes and ground with contact jelly are taped on the patient's chest. The diaphragm compound action potential is recorded by placing electrodes at three locations on the patient's anterior chest.

We tape the G1 electrode just below the xiphoid, although some references suggest placement 5 cm above the tip of the xiphoid. The G2 electrodes (2) are placed approximately 16 cm from G1, inferolaterally on the left and right costal margins below the nipple. A ground strap is placed on the upper chest. EKG leads are placed, and a transcutaneous monitor is fixed to the upper chest.

Esophageal and gastric balloons are placed via one nare after prepping with topical xylocaine jelly mixed with lidocaine solution. Compliance testing is usually performed on a MedGraphics RPM unit after optimizing placement by adjusting position while observing the most negative pressure for the esophageal catheter and positive readings for the gastric catheter. Approximate expected catheter depths are pre-determined based on patient size and build prior to placement.

MIP, MEP, and Sniff testing are performed, observing mouth pressure and trans-diaphragmatic pressure differences. Stimulation of the phrenic nerve is obtained by placing the surface stimulator posterior to the sternocleidomastoid muscle just above the clavicle, at the level of the cricoid, and applying electrical stimulus. Increasing electrical stimulus is attempted until maximal values plus 25% are obtained. Once optimal placement and electrical stim levels are determined, twitch PDI (trans-diaphragmatic pressures) are obtained.

The patient is coached to close his or her eyes, and breathe normally through a three-way valve. At an end tidal breath, the valve is closed to the patient, and the phrenic nerve is given an electrical stimulus. Pressure transducers connected to the gastric and esophageal catheters record results to calculate the twitch PDI, a non-effort dependent. The PDI is the pressure generated by the diaphragm and is the difference between the intra-abdominal pressure measured by the gastric pressure catheter (Pg) and the pleural pressure (Ppl), estimated from the esophageal pressure (Pes). Pdi = Pg – Pes. The stimulus is repeated several times on each side to ensure reproducible results. The stimulator is usually set to .1 msec for duration and usually set at a max of 100 m-amps. Results are printed for analysis.

Problems that may be encountered include—

Stimulating the vagus nerve, which is 2-3 cm medial to the phrenic nerve.

Stimulating the bracheal plexis, which is 1 cm lateral to the phrenic nerve.

Direct stimulation of the sternocleidomastoid muscle; to avoid try to push under the muscle gently.

Patients with large or short necks can be difficult; larger shocks may be necessary.

The majority of our patients proceed to have a graded exercise test with the balloon catheters still in place. The PDI is measured throughout the exercise, and inspiratory capacity maneuvers are performed twice each minute throughout the exercise. Post exercise, sniffs, and muscle forces are repeated for comparison to pre-exercise.

With training through a neurology department or through the American Association of Electrodiagnostic Medicine seminars, respiratory therapists can expand their skills to further evaluate patients with a neuro-pulmonary disorder. Other options for this testing would be a cooperative venture between a neurology department and pulmonary department. EMG techs could be called to an exercise room to perform testing at the appropriate stage of the evaluation. It is helpful for the proper patient diagnosis to perform simultaneous testing with the two disciplines rather than separately and to visualize the dynamic changes with exercise, and pressure changes in the lungs when the nerve stimulations are measured.

Further reading

Bolton, Charles M.D. Electromyography of the Respiratory Neuromuscular System. An American Association of Electrodiagnostic Medicine Workshop

Markland et al, Electrophysiologic Evaluation of the diaphragm by transcutaneous phrenic nerve stimulation Neurology (NY) 34:604-614 1984.

Becker, Frank and Martinez, Fernando. Respiratory Muscle Testing in the ICU. RT journal October/November 1993.

CASE STUDY #1:
C/O SYNCOPE WITH EXERCISE

by Catherine M. Foss, BS, RRT, RPFT

Editor's Note: The following study comes from the University of Michigan pulmonary lab.

A 31-year-old man presented with c/o spells of weakness and alteration of consciousness brought on by exertion. These episodes had occurred since early childhood. He was in otherwise good health between spells.

His disorder had been previously attributed to seizure activity, but did not respond to therapy. These spells occurred with mild exertion and interfered with his job activities. He could stop a "spell" by resting if he felt the weakness beginning. He had been evaluated by cardiology, with all findings normal. He was referred to a neurologist who decided to evaluate the patient in partnership with the pulmonary department for possible mitochondrial disease.

The EEG was normal. The PFT, including spirometry, lung volumes, and diffusion, was normal. Esophageal and gastric balloons were placed via one nare after prepping with topical xylocaine jelly mixed with lidocaine solution. Compliance testing was performed on a MedGraphics RPM unit after optimizing placement by adjusting position while observing the most negative pressure for the esophageal catheter. MIP, MEP, and Sniff testing were performed and found to be reproducibly low.

The patient performed compliance testing which was within normal limits, but the maximum pressure was decreased. The patient performed a graded exercise test on a bicycle ergometer at a 20 watt per min step protocol, utilizing a Collins metabolic/exercise cart. An arterial line was placed and blood gases and lactate levels were drawn at baseline and every 2 minutes throughout the test, along with peak exercise. 12 lead ECG was continually monitored and a Colin Blood Pressure instrument recorded data every 2 minutes. Two ICs (inspiratory capacity maneuvers) were performed every minute, followed by patient documentation of dyspnea via both Visual Analog and Borg scales.

The exercise was terminated due to loss of consciousness of the patient seven minutes into the protocol, (100 watts). The loss of consciousness was NOT accompanied by any cardiac instability; no vagal response or arrhythmias were seen. No respiratory insufficiency was noted, and no hypoglycemia was found. The exercise was below predicted work levels, with a low AT and O_2 pulse. The heart rate response was markedly elevated. Lactate levels were mildly elevated at rest and showed a marked elevation with exercise. Testing showed hyperventilation at the end of exercise, in probable response to the acidosis. Blood gases showed no desaturation, and acidosis at peak exercise. The patient was unable to perform spirometry post exercise until 45 minutes after exercise was terminated, due to decreased level of consciousness.

Due to the elevated lactate levels, suspicions were raised that the patient suffered from a metabolic disorder. Carnatine and pyruvate blood levels were sent off, and eventually a muscle biopsy was performed to confirm the diagnosis of mitochondrial myopathy. This patient was unable to utilize oxygen at a cellular level. Without testing beyond normal exercise testing, this type of patient would present a puzzling picture without a definitive disease diagnosis. Clearly, cross disciplinary team cooperation facilitates proper diagnosis for difficult cases.

CASE STUDY #2:
C/O WHEEZING AND SYNCOPE WITH EXERCISE

by Catherine M. Foss, BS, RRT, RPFT

Editor's Note: The following study comes from the University of Michigan pulmonary lab.

A 17-year-old young man presented with c/o episodes of wheezing and loss of consciousness brought on by exertion. These episodes had occurred in the last year during high school athletics. He was in otherwise good health between episodes. His disorder had been previously attributed to exercise-induced asthma, but did not respond to therapy. These spells occurred with moderate to severe exertion and interfered with his team activities.

He had been evaluated by cardiology with all findings normal. He was referred to an allergist who decided to evaluate the patient in partnership with the pulmonary department and otolaryngology department for possible exercise-induced asthma vs. vocal cord dyskinesia. The PFT, including spirometry and MVV, was normal. Muscle force testing, MIPs, and MEPs were normal. The patient performed a graded exercise test on a treadmill, utilizing a Collins metabolic/exercise cart. No blood gases were drawn; pulse oximetry and transcutaneous monitoring were performed continuously. 12 lead ECG was continually monitored and a Colin Blood Pressure instrument recorded data every 2 minutes. Two ICs (inspiratory capacity maneuvers) were performed every minute, followed by patient documentation of dyspnea via both Visual Analog and Borg scales.

The exercise was terminated by the patient due to difficulty breathing and dizziness 21 minutes into the protocol, (at 20% grade and a speed of 7 mph). In the last 5 minutes of exercise it was noted that the patient was using accessory muscles with IC maneuvers, with exaggerated shoulder shrug. In the last two minutes of exercise the patient hunched over, and in the last minute of exercise audible stridor could be heard. Oxygenation was preserved as noted by the transcutaneous monitor. As soon as the patient signaled that he was at max, he was assisted off the treadmill and immediately underwent fiberoptic laryngoscopy. The study confirmed vocal cord dyskinesia. The patient subsequently was seen by the Otolaryngology clinic for training and therapy for this disorder so he could resume his athletic career.

Again, cross disciplinary team cooperation facilitates proper diagnosis for difficult cases.

SPOTLIGHT CORNER

Editor's Note: This is a new section of the Bulletin designed to highlight labs that are initiating or participating in new or innovative programs.

Dee Seabaugh, CRTT, CPFT, has worked in a small pulmonary lab at 260-bed St. Francis Medical Center in Cape Geraldo, MO, for six years. After her initial training with her Body Plethysmograph/PFT system six years ago, she mainly performed spirometry pre- and post-bronchodilator, lung volumes, and diffusion studies. Since the physicians at her institution never requested airways resistance studies, Dee concentrated on perfecting her skills in the basic testing in which she was trained. Still, she wanted to enhance her diagnostic education training, so last year she attended

a lecture series presented by National Jewish Hospital and sponsored by MedGraphics Corporation. Many of the experts in the diagnostic field were presenters at this lecture series.

Dee's horizons were expanded as she learned more about the importance of the information that could be generated using a body plethysmograph. She took back a lot of this information to present to the physicians she works with.

In her institution, PFTs are ordered and interpreted primarily by allergists, pulmonologists, and family practice physicians who cover interpretation duties on a rotating basis. After the conference, Dee met regularly with these physicians to present the airways resistance information she had gained. Research was also conducted to assist the physicians in interpretative strategies for R_{AW} and s_{GAW}.

After sharing this information with the medical staff at the hospital, Dee began performing airways resistance testing for these physicians on a routine basis. Now the group plans to include information on airway resistance testing in an asthma and allergy symposium scheduled for this spring.

Dee's initiative in seeking out new information about pulmonary testing has paid off, both in terms of increasing the capabilities of her lab and enhancing her own professional responsibilities. She plans to continue to expand her education and would like to sit for the RPFT exam in the future.

INHALED NITRIC OXIDE

by Linda M. Folk, RRT

Linda Folk is a clinical specialist in critical care support services at the University of Michigan Medical Center.

The inhalation of nitric oxide (NO) is a new therapy that has sparked much interest and scientific research. Due to the mode of delivery and the patient population which may benefit from this therapy, inhaled NO has landed on the doorstep of the respiratory care practitioner. This simple gas appears to be involved in a range of functions, including airway and vascular smooth muscle relaxation, pulmonary neurotransmission, host defense, and cytotoxicity. Nitric oxide is an endothelial-derived relaxing factor. It is synthesized in the endothelial cells of arteries and veins and in the smooth muscle cells. Nitric oxide synthase (NOS) is responsible for the production and release of NO.

One form of NOS, constitutive NOS (cNOS), is found in the endothelial cells and is dependent on the influx of calcium into the endothelium. It is stimulated by blood flow across the endothelium. Another form of NOS, inducible NOS (iNOS), is found in the vascular smooth muscle and is triggered by endotoxin, tumor necrosis factor, and interleukins. It is this enzyme that is most likely responsible for the release of nitric oxide in septic shock, resulting in severe vasodilatation. There are studies now in progress evaluating the effects of drugs that will block the triggers of iNOS.

Clinical use of NO at this time is focused primarily at adult patients with primary pulmonary hypertension (PPH), some cardiothoracic surgical procedures, adult respiratory distress syndrome (ARDS), and persistent pulmonary hypertension in the newborn (PPHN). Pulmonary vascular tone is a result of the balance of vasoconstriction and vasodilatation. Release of NO from the pulmonary vascular endothelium may be impaired in patients with ARDS, in patients who have undergone cardiopulmonary bypass, and in patients with COPD or cystic fibrosis.

Inhalation of NO has been shown to selectively vasodilate the pulmonary vessels in these patients, using a range from 5-80 parts per million (ppm). As NO reaches the blood, it is quickly inactivated by hemoglobin, thus eliminating systemic vasodilatation. When exposed to oxygen, NO is oxidized to nitrogen dioxide (NO_2), which is cytotoxic and will result in histopathological changes in the lung. The rate at which NO converts to NO_2 depends on the NO concentration and the FIO_2. The higher the FIO_2 and the higher the NO concentration, the quicker it converts to NO_2.

While uncommon, methemoglobin has been reported with use of NO. Therefore, methemoglobin, NO_2, and NO must be monitored continuously, with 3 ppm NO_2 as the upper limit. The exhaled gases are scavenged from the circuit to prevent significant exposure of the environment with NO. The effects of NO cease as soon as it is removed from the breathing circuit.

The RCP is closely involved in the care of these types of patients everyday, monitoring the mechanics of the respiratory system, cardiac parameters (i.e., cardiac ouput, systemic vascular resistance [SVR], pulmonary vascular resistance [PVR] and arterial blood gases. In studies involving mechanically ventilated patients, the RCP is an integral part of the process, ensuring correct delivery of the drug through the ventilator, continuous monitoring of NO and NO_2 with a chemiluminescence monitor, obtaining hemodynamic variables and arterial blood gases, and ensuring that the scavenging system connected to the ventilator is functioning properly.

Most of the work being done with NO is of a therapeutic, temporary nature on very sick patients in the hospital. Patients with PPH are primarily treated on an outpatient basis. They have a disease process that has, in part, a "fixed" resistance to blood flow. Treatment is limited to vasodilators that are not selective in effect; therefore a significant reduction in PVR may well lead to a significant reduction in SVR. Inhaled NO, however, may result in a significant decrease in only the PVR (not SVR) in patients with a "responsive" component to their disease.

We are currently involved in a study in which inhaled NO is being evaluated as a method of determining which patients might have a "responsive" component to their PPH. These patients have a pulmonary artery catheter placed to obtain vascular pressures and cardiac outputs. Baseline parameters are obtained before they are given 80 ppm NO via a closed system non-rebreathing mask for five minutes. Those who show a reduction in mean pulmonary artery pressures are treated with nifedipine. Those who don't respond are treated with prostacyclin. This may provide a more efficient means of determining treatment modality on this patient population. Unfortunately, at this time NO is not available for use on an outpatient basis, but the idea of NO responders being able, in some way, to use low levels of the gas is intriguing.

Inhaled NO is an area of research that continues to grow, with possibilities ranging from therapeutic use in the ICU to diagnostic studies on outpatients with PPH. Both of these areas will require the expertise of the RCP in the safe use and delivery of NO. Therefore, it is important for the RCP to become knowledgeable in the biology of nitric oxide and the recent advances that have been made in this field.

INCREASE IN CROSS-UTILIZATION OF RESPIRATORY CARE PRACTITIONERS

by Vickie Ganey, MBA, RRT, RPFT, RN

In "A Position Paper Prepared for the National Conference on Multiskilling and the Allied Health Workforce," the AARC advocates the use of multiskilled or cross-trained respiratory care practitioners. This is not a new concept, but something that has been a topic of discussion since the 1980s.

At the time of the report, 79.1% of the respiratory care departments polled indicated that they were providing clinical procedures other than the traditional tasks of intermittent respiratory therapy, therapeutic gas administration, chest physiotherapy, diag-

nostic pulmonary tests, and ventilatory support. The non-respiratory related services were primarily in invasive and non-invasive cardiac diagnostics, extracorporeal membrane oxygenation (ECMO), and health education.

In a 1992 respiratory care practice survey of hospitals nationwide done by Arthur Anderson and the AARC, the expansion of respiratory care departments into other areas of practice, such as bronchoscopy, cardiac rehabilitation, electrocardiograms, electroencephalography, ECMO, hyperbaric oxygenation, invasive cardiac testing, non-invasive cardiac testing, and sleep lab studies was gauged. This survey again showed the RCP's flexibility in adapting to change and indicated that members of our profession are excellent candidates for cross-training.

When talking with hospital administrators and medical directors about increasing the RCP's duties and responsibilities in the hospital, the RCP manager can point out the following advantages—

- RCPs are on the premises seven days a week, 24 hours a day.
- RCPs are already used as multiskilled providers in many hospitals.
- Certification of RCPs requires education in physics, biology, pharmacology, anatomy, and other laboratory sciences. They can quickly learn new clinical procedures.
- RCPs have a skill base of more than 100 clinical interventions.
- RCPs are trained to use complex, high-technology medical equipment.
- RCPs currently provide services in settings covering the full continuum of care.

With today's changing health care environment, it is essential that the RCP be the one to "drive the cart." We have to push for the change we want before the change we don't want is made. As professionals with the ability to learn, we need to be the ones to provide the multiskilling needed in health care. Take the time to look at what is being done, who is doing it, the training involved, and the education needed, then learn the procedure. Use your knowledge to improve your marketability in the health care system.

Remember that respiratory care has always been a field of change. We have already evolved from "inhalation therapy" to "respiratory therapy" to "respiratory care," and now we are looking at "cardiopulmonary" and "cardio/respiratory." The respiratory system is tied to every system in the body and our training and knowledge should allow us to do the same.

JCAHO ACCREDITATION VISIT REPORTS

In an effort to keep you informed regarding JCAHO site visits, the AARC has been requesting information from organizations that have recently gone through the review process. (See JCAHO Accreditation Visit Form in this issue to provide input on your visit.) Here are six recent responses—

Homecare Medical Associates, Inc. (Home care)
6600 NW 12th Avenue
Ft. Lauderdale, FL 33309
Contact: Jay J. Gutierrez, RRT, (954) 772-5052
Inspection Date: 1994

1. What was the surveyors' focus during your last site visit?
   QA / Infection control/documentation/pt care plans.
2. What areas were cited as being exemplary?
   QA
3. What suggestions were made by the surveyors?
   Further documentation on corrective actions taken/measure impact.
2. What changes have you made to improve compliance with the guidelines?
   More follow-up and documentation on any actions taken to correct a deficiency.

Additional comments: *More emphasis is being given to performance improvement. Patient care.*

Virginia Mason Home Care (Home care)
925 Seneca St., Mailstop H4HHE
Seattle, WA 98111
Contact: Kathy Baillie, (206) 340-2011
Inspection Date: August 1995

1. What was the surveyors' focus during your last site visit?
   DME/clinical respiratory services.
2. What areas were cited as being exemplary?
   Clinical respiratory.
3. What suggestions were made by the surveyors?
   Needed improvement in infection control monitoring.
4. What changes have you made to improve compliance with the guidelines?
   Changed policy & procedure.

Additional comments: *None*

The Jewish Hospital (Hospital)
3300 Burnet Avenue
Cincinnati, OH 45229
Contacts: Debbie Nesbit, Manager; Jackie Caccia, Supervisor
(513) 569-2125
Inspection Date: November 18-21, 1996

1. What was the surveyors' focus during your last site visit?
   Life safety issues, policies on patient restraints, multidisciplinary approach to patient care.
2. What areas were cited as being exemplary?
   Performance improvement, multidisciplinary focus.
3. What suggestions were made by the surveyors?
   Change some paperwork to reduce redundancy.
4. What changes have you made to improve compliance with the guidelines?
   Definitive changes not yet decided. Final report not yet in - preliminary report indicates our final grade will be 97-98 with possible commendation (which we've earned in last 2 reviews).

Additional comments: *Unlike reports we had previously received, respiratory was not a "focus" issue. We were included on all clinical visits (and questioned) and a part of multiple administrative reviews.*

Sacred Heart Hospital (Hospital)
5151 N. 9th Avenue
Pensacola, FL 32504
Contact: Cindy Carter, RRT, (904) 416-7760
Inspection Date: October 28, 1996

1. What was the surveyors' focus during your last site visit?
   Bronchoscopy service, H & P, conscious sedation, bronch reports.
2. What areas were cited as being exemplary?
   Protocols that showed ↓ LOS/↑ (improved) pt outcomes, TQM problem solving process.
3. What suggestions were made by the surveyors?
   Improve process for positive bronch reports on in & out patients and forwarding to physicians. Could simplify H & P if info was sent w/pt from physician's office.
4. What changes have you made to improve compliance with the guidelines?
   Worked w/medical records and transcription to utilize reporting

options available to reduce turnaround time and issue multiple reports to appropriate physicians and to pts chart for inpts.

Additional comments: *In cases where needle re-capping is done, state that a needle re-capping device is used, or the syringe cap is not held when the needle is inserted into the cap. They did ask about where bronchoscopes were cidexed and monitoring employee exposure to sources of radiation in the bronchoscopy suite.*

Ambassador-Lincoln (Long term care)
4405 Normal Blvd.
Lincoln, NE 68506
Contact: Tad Hunt, RRT, (402) 488-2355
Inspection Date: July '96

1. What was the surveyors' focus during your last site visit?
   LTC/Subacute care rehab.
2. What areas were cited as being exemplary?
   Rehab/respiratory.
3. What suggestions were made by the surveyors?
   Performance improvement/environment services.
4. What changes have you made to improve compliance with the guidelines?
   Formulated teams to implement changes.

Additional comments: *JCAHO accreditation in long term care and subacute care.*

Medical Center of SW Louisiana (Pathology & Clinical Laboratory Services)
2810 Ambassador Caffery
Lafayette, LA 70506
Contact: Sharon Real, (318) 989-6713
Inspection Date: January 17, 1997

1. What was the surveyors' focus during your last site visit?
   Licensure of employees, documentation, verification of proficiency testing.
2. What areas were cited as being exemplary?
   Documentation of sample review on complement (CIBA CORNING/CHIRON).
3. What suggestions were made by the surveyors?
   Use of orientation checklist for annual competency testing.
4. What changes have you made to improve compliance with the guidelines?
   Change wording on annual review form to include the word "competent."

Additional comments: *Surveyor checked* every *employee folder for valid state licensure verification*

FYI...

Kids with moderate to severe asthma benefit from intravenous magnesium therapy

A randomized, double-blind, placebo-controlled study of 31 asthmatic children seen in the emergency room with peak expiratory flow rates of less than 60% of predicted value after receiving three beta$_2$-adrenergic nebulizer treatments found that intravenous magnesium therapy significantly improved short-term pulmonary function. Children who were given the magnesium therapy exhibited greater improvements in PEFR, FEV$_1$ and FVC, and were admitted to the hospital less often than those who did not receive the treatment. The study was conducted at Rhode Island Hospital in Providence and published in *The Journal of Pediatrics* last December. (Source: Reuters Medical News, 12/31/96)

Extensive testing not necessary for IPF patients

Extensive lung tests, such as gas exchange at rest and during exercise, are not effective in estimating prognosis for patients with idiopathic pulmonary fibrosis (IPF), say German researchers. Standard pulmonary function tests are sufficient.

The group tested nearly 100 IPF patients for lung volumes, arterial oxygen tension, and gas exchange at rest and during bicycle exercise to arrive at their findings. Factors influencing prognosis included the degree of restrictive lung function and age at presentation. Patients with higher lung capacity had higher survival rates while those over the age of 50 had lower survival rates. Sixty-four percent of the patients were still alive five years after diagnosis. The study was published in *Chest*. (Source: Reuters Medical News, 2/6/97)

Kids with ADHD, behavioral problems may suffer from sleep disorders

Two new studies suggest a link between sleep disorders and behavioral problems and attention deficit hyperactivity disorder (ADHD) in children.

Researchers from Brown University who studied 52 children with ADHD and 52 children with behavioral and learning problems found that 63% of the ADHD group suffered from sleep problems. Thirty-seven percent of the group with behavioral/learning problems had trouble sleeping. The most common problem in the ADHD group was taking more than one hour to fall asleep at night.

The Brown study, which was published in the December issue of *Pediatric News*, was accompanied by another study from researchers who found that three and four-year-olds with behavioral problems not associated with disabilities or premature birth were six times more likely to suffer from sleep problems than those without behavioral problems.

Researchers in the Brown study conclude that all children with ADHD should be tested for sleep disorders. (Source: Reuters Medical News, 1/6/97)

U3P may compromise CPAP success for sleep disorders

Scottish researchers who tested the ability of snorers to tolerate nasal CPAP without mouth leak or appreciable discomfort while awake found that those who had undergone uvulopalatopharyngoplasty (U3P) fared worse than those who had not. All 13 patients who had undergone U3P demonstrated mouth leak at low pressures and were unable to tolerate nasal CPAP at pressures within the normal therapeutic range. Thirteen normal nonsnoring subjects and 13 with sleep apnea/hypopnea syndrome who had not received U3P were able to tolerate CPAP without mouth leak.

The group believes that loss of the soft palatal seal increases the mouth air leak. Since U3P is often ineffective in treating snoring or sleep apnea/hypopnea, they believe their findings indicate that it should not be used as a first line treatment because it could

compromise subsequent success with CPAP. The study was published in the *American Journal of Respiratory and Critical Care Medicine*. (Source: Reuters Medical News, 12/20/96)

LVRS research sites announced

The National Heart, Lung, and Blood Institute has announced the long-awaited sites for the first multi-center trial of lung volume reduction surgery (LVRS). The study, which will be designed to show whether or not the procedure is safe and effective for the treatment of end-stage emphysema, will enroll approximately 2,600 patients from a registry set up at the participating centers. All patients will receive intensive medical therapy and rehabilitation, then half of the group will undergo LVRS. Their outcomes will be compared with the half of the group receiving therapy alone. The study will be coordinated by Steven Piantadosi, MD, and his colleagues at the Johns Hopkins University in Baltimore, MD.

Clinical centers included in the study are shown below.

NAEPP releases updated asthma guidelines

The National Asthma Education and Prevention Program released its long-awaited update of the 1991 Guidelines on the Treatment of Asthma in late February. While the new guidelines do not represent a major deviation from the original guidelines, Expert Panel members say they reflect new developments in drug therapy and the results of scientific studies that have helped to clarify many of the issues involved in asthma care since the original guidelines were released.

Among other things, the revised guidelines include new classifications of asthma severity aimed at assisting physicians in determining appropriate levels of treatment for particular patients. They also call for full pulmonary function tests upon diagnosis, followed by yearly or bi-yearly testing to monitor the effects of disease control.

In addition, the guidelines ask health care professionals to—

HOSPITAL	PRINCIPAL INVESTIGATOR	PATIENT REFERRAL
Baylor College of Medicine, Houston, TX	Rafael Espada, MD (713) 798-4556	Charles Miller (800) 622-9567
Brigham & Women's Hospital, Boston, MA	John J. Reilly, MD (617) 732-7420	Tammy Weihrauch (888) 294-5864
Cedars-Sinai Medical Center, Los Angeles, CA	Robert McKenna, MD (213) 977-1170	Brenda Williams (800) CEDARS-1
Cleveland Clinic Foundation, Cleveland, OH	Janet R. Maurer, MD (216) 444-6505	(800) 822-9488
Columbia University, New York, NY	Mark Ginsburg, MD (212) 305-3408	Patricia A. Jellen, MSN, RNC (212) 305-1158
Duke University Medical Center, Durham, NC	Neil R. MacIntyre, MD (919) 681-2720	Janet Johns (919) 681-2720
Mayo Clinic, Rochester, MN	Rolf D. Hubmayr, MD (507) 255-5441	Kristen A. Bradt (507) 284-4619
National Jewish Center for Immunology and Respiratory Medicine, Denver, CO	Reuben M. Cherniack, MD (303) 398-1503	Lung Line (800) 222-LUNG
Ohio State University, Columbus, OH	Philip T. Diaz, MD (614) 293-4925	Mary Lou Coffee (614) 293-4509
Saint Louis University, St. Louis, MO	Keith S. Naunheim, MD (314) 577-8360	Gina Roelke (800) 268-5880
Temple University, Philadelphia, PA	Gerald J. Criner, MD (215) 707-8113	Anne Marie Kuzma, RN (215) 707-1334
University of California, San Diego Medical Center, San Diego, CA	Andrew Ries, MD (619) 294-6068	Trina Limberg, BS, RRT (619) 294-6066
University of Maryland at Baltimore, Baltimore, MD	Mark J. Krasna, MD (410) 328-6366	Karen King, RN (410) 328-2168
University of Michigan, Ann Arbor, MI	Fernando J. Martinez, MD (313) 936-5201	Telecare (800) 742-2300, Routing #6235
University of Pennsylvania Medical Center, Philadelphia, PA	Larry Kaiser, MD (215) 662-7538	Penn Health Customer Service (800) 789-PENN
University of Pittsburgh, Pittsburgh, PA	Robert J. Keenan, MD (412) 648-8474	Betsy George, RN (412) 648-6736
University of Washington, Seattle, WA	Richard K. Albert, MD (206) 543-3166	Doctors, Inc. (800) 826-1121
Washington University, St. Louis, MO	Joel D. Cooper, MD (314) 362-6021	Deen Scharff (314) 362-6044

- Involve the patient in monitoring symptoms.
- Educate patients on the role the environment plays in the development of symptoms and instruct them in ways to avoid exposure to allergens such as dust or secondhand smoke.
- Develop a heightened sensitivity to the patient's cultural beliefs.
- Monitor the patient's perception of his/her "quality of life" in order to gauge progress.
- Devise a patient "action plan" that can be implemented by the patient when symptoms worsen.

(Source: Reuters)

ARCF Announces Helmholz Research Fund Application Change

In 1994, The National Board for Respiratory Care/Applied Medical Professionals (NBRC/AMP) established an endowment to the American Respiratory Care Foundation (ARCF) to provide support up to $3,000 for educational or credentialing research, a Master's thesis, or Doctoral dissertation with practical value to the respiratory care profession. This educational research endowment is named for H. Frederic Helmholz, Jr., MD, in recognition of his outstanding contributions to the respiratory care profession.

The ARCF has approved a more "user-friendly" application that can be submitted at any time during the year. The ARCF trustees feel the new, simplified application is more relevant to education research and is tailored to assist individuals applying for credential-related research grants. The Helmholz award will include registration, round-trip airfare and one night's lodging to the 1997 AARC International Respiratory Congress in New Orleans, LA.

Applications may be obtained through the ARCF Executive Office at 11030 Ables Ln., Dallas, TX 75229-4593, (972) 243-2272.

1997 OPEN FORUM is your voice to the ear of the respiratory care profession!

The issues that are near and dear to your heart are valuable to the entire body of AARC professionals.

Your original study, evaluation of a method, device, or protocol, or a case report or case study is important. Submitting it is as easy as calling the editorial office at 972-243-2272 or looking for the 1997 Call for Abstracts in each issue of RESPIRATORY CARE.

Final Deadline: May 27, 1997

RESOURCE PANEL UPDATE

An updated version of our Resource Panel appeared in the Fall issue of the *Bulletin*, but we are still looking for additional qualified members to add to the list. If you would like to participate in the panel, fill out the form below (we ask that you limit yourselves to ten topics or less) and return it to one of the *Bulletin* editors at the addresses listed on the last page of this issue. Another update will be coming soon.

___New Panel Member ___Returning Panel Member w/Changes

___Please drop my name from the panel

Name: _____

Title: _____

Institution: _____

Complete address(es) (work and/or home)

_____

_____

_____

_____

_____

Phone(s): _____

Fax: _____

E-mail (if available) _____

TOPICS

Pulmonary Diagnostics
___ Spirometry
___ Lung volumes
___ Airway Mechanics
___ Diffusing Capacity
___ Steady State Diffusing Capacity
___ Blood Gas, Electrolyte and Hemoximetry Analysis
___ Point of Care Testing
___ Bronchoscopy
___ Sweat Chloride Testing
___ Conscious Sedation
___ Cardiopulmonary Exercise Testing
___ Airways Challenge Testing
___ Pulmonary Mechanics and Occluding Pressures
___ Sleep Disorders
___ High Altitude Simulation
___ Ventilatory Drive

Critical Care Pulmonary Diagnostics
___ Indirect Calorimetry
___ Noninvasive Cardiac Diagnostics

Pediatric and Neonatal Care
___ Neonatal, Infant, Toddler, and Pediatric Pulmonary Diagnostics
___ Pediatric Bronchoscopy
___ Research
___ Occupational Health
___ Administrative Management
___ Rehabilitation & Education
___ Patient Focused Protocols
___ Clinical Practice Guidelines

JCAHO Accreditation Visit Report Form

The following survey form is provided to enable the reporting of recent JCAHO accreditation site visits. Compiled results will be published regularly through select section newsletters and the *AARC Times*. Please return your completed survey to:

William H. Dubbs, MHA, RRT
AARC Director of Management Services
11030 Ables Lane
Dallas, TX 75229-4593
Phone # (972) 243-2272 Fax # (972) 484-2720

Inspection Date: _____

Name: _____

Facility: _____

Address: _____

_____

_____

Phone: _____

If you are willing to discuss your accreditation visit with others check this box ☐ and this information will be added to a list that is available to AARC members. If you do not check the box your response will remain anonymous.

Please check the type of accreditation visit you are reporting:

Pathology & Clinical Laboratory Services ☐

Hospitals ☐

Home Care ☐

Long Term Care ☐

What was the surveyors' focus during your last site visit?

What areas were cited as being exemplary?

What suggestions were made by the surveyors?

What changes have you made to improve compliance with the guidelines?

Please offer any additional comments about the site visit that will be helpful to others. (use additional sheet if necessary)

_____

_____

_____

OUTSTANDING SECTION MEMBER OF THE QUARTER: *NOMINATION FORM*

Don't forget to make your nominations for the Diagnostics *Outstanding Section Member of the Quarter* award. The winner of each *Outstanding Section Member of the Quarter* award will be featured in an article in the Bulletin and our *Specialty Practitioner of the Year* will be chosen from these four winners. The winner of the *Specialty Practitioner of the Year* award will be honored during the Awards Ceremony at the AARC Convention.

The recipient of this award will be determined by the section chair or a selection committee appointed by the chair. Each nominee must be a member of the AARC and a member of the section.

Use the following form to send in your nominations for this important award—

I would like to nominate _____ for Diagnostics *Outstanding Section Member of the Quarter* because

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____	_____
Nominee	Your Name
_____	_____
Hospital/School	Hospital/School
_____	_____
Address	Address
_____	_____
City, State, Zip	City, State, Zip
_____	_____
Phone	Phone

Mail or FAX your nomination to the Section Chair at the address/number listed on the last page of this issue.

AMERICAN ASSOCIATION FOR RESPIRATORY CARE

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Deadlines for submitting copy for publication in the *Bulletin*—

ISSUE	DEADLINE	THEMES
Summer	May 1, 1997	Pulmonary
Fall	August 1, 1997	Sleep Studies, Bronchoscopy
Winter	October 1, 1997	Laboratory (ABG, electrolyte, metabolyte, Co-Ox)

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