Diagnostics Bulletin

Issue No. 2

Notes from the Chair

by Carl Mottram, RRT, RPFT

This issue of the Bulletin is dedicated to the pulmonary function test (PFT). The PFT is the bread and butter of pulmonary diagnostics, yet even with this time-tested procedure there are many issues related to quality assurance that have not been addressed. The AARC has been a leader, through its Clinical Practice Guideline process, in addressing issues of standardization and quality in pulmonary diagnostics. As I correspond with my colleagues around the country, it is evident that continuing to strive for excellence in our routine testing is essential.

I would like to thank everyone who contributed to this endeavor by writing for this issue of the Bulletin. To all my colleagues, I offer this one statement — just keep questioning. ■

Notes from the Medical Director

by Peter A. Southorn, MD

In a highly publicized trial, my state, Minnesota, along with Minnesota Blue Cross Blue Shield, is currently suing the major tobacco firms. This case and the ongoing national debate on how to stop young people from beginning to smoke highlights a vital public health issue.

Young people continue to start smoking without appreciating the fact that once they're hooked on nicotine, it is so difficult to give up the habit. Despite overwhelming evidence that cigarette smoking over the years produces COPD and an increased incidence of lung cancer, pneumonia, heart disease, and other problems, they proceed to get "hooked." Respiratory therapists have sought to have a positive impact on this problem by trying to convince people not to start smoking. By participating in spirometry studies, we can also help smokers give up their cigarettes before the latter causes irreparable harm to their lungs. No other test can do this.

Coughing, sputum production, and wheezing occurring early in COPD are non-specific symptoms which rarely concern the patient. It is only when the patient starts developing dyspnea, a symptom that the patient often first attributes to being out of shape, that the alarm bells ring. Unfortunately, by this time the COPD is usually fairly advanced. Spirometry's value lies in its ability to demonstrate COPD by showing an accelerated decline in the patient's FEV1 years before the onset of dyspnea on exertion. This is a win-win situation for the patient and society alike, because if smoking is stopped, one can arrest the accelerated decline in the patient lung function. As a result, the patient's quality of life is improved and society is saved some of the staggering health costs associated with caring for patients with COPD.

Promoting the widespread use of such spirometry testing, both inside and outside the hospital, would be a worthwhile initiative for those of us involved in respiratory diagnostics. ■

Alternative Choices Are Now Available for Metered Dose Inhalers!

by Mary K. Collins RRT, RPFT

Editor's Note: The following article is an overview of a lecture presented recently by allergist Mike Kramer, MD.

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The Technical Options Committee of the Montreal Protocol, which governs the coming worldwide ban on chlorofluorocarbons, granted the United States an exemption for 1996 and 1997 for metered dose inhalers, forcing the FDA to approve the new non-CFC products by 1998. Two alternative propellants called hydrofluoroalkanes (HFAs) are now available for use in the production of MDIs.

HFAs have the right characteristics to be good MDI propellants. They are safe for human use and have been approved by the Environmental Protection Agency (EPA). They do not contain chlorine, and they breakdown in the atmosphere faster then CFCs.

In 1997 the first non-CFC propellant, HFA134a, was approved for the US market and released by Key Pharmaceuticals as Proventil HFA. In addition to saving the ozone layer within our atmosphere, use of this propellant has permitted a complete overhaul of the metered dose inhaler, leading to several added benefits. The drug is the same, so it has similar safety and efficacy to CFC albuterol in clinical comparisons. It should not cost the patient any more than previous CFC inhalers. However, the Proventil HFA needs less priming, even if it has been stored for up to two weeks. This should actually save money for some patients. Proventil HFA is said to have more reliable delivery in cold weather compared to CFC inhalers. It also has greater consistency per puff, from the first dose to the last. In studies it had less of a "tail off" in potency in the last few doses of the vial.

For the first time, doctors, patients, and the entire pharmaceutical industry are being forced to make a transition from one form of medical device to another for reasons other than direct patient safety or improved efficacy. This transformation to non-CFC metered dose inhalers will have quite an effect on the delivery of asthma and allergy care. The public reaction is decidedly mixed.

It is important that the phase-out of CFC-containing MDIs be conducted as smoothly as possible, with the least amount of disruption in the medical care of patients. Asthma patients should be educated that they will soon be using a new type of inhalant device. As pulmonary diagnosticians, we should take the opportunity to inform our patients of the differences and similarities between CFC and non-CFC inhalers. Specifically, non-CFC inhalers will taste and feel different when dispensed. The softer spray may be easier to inhale, especially for patients who have had problems with bronchospasm when inhaling CFC MDIs. It may be more reliable in cold weather, and there is no need to prime the inhaler after the first dose, which should save patients medicine and money. However, the patient will still get the same medication. They will still get the same relief.

Due to the US commitment to the Montreal Protocol, more than 25 new MDI products are expected to be approved within the next two years. We can make this transition easier for all concerned by educating ourselves about the new HFA products, as well as the new dry powder inhaler (DPI) products, as they become available. ■

Methacholine Challenge Testing: 1998 Update

by Jack Wanger, MBA, RRT, RPFT, IMTCI, Lenexa, KS

It has been a little over two years since I last wrote about the problems of, and alternatives to, obtaining methacholine. At that time, Provocholine, an FDA approved product, was not available because of what the manufacturer stated as "production problems." The alternatives for obtaining the drug then were: (1) buy from a chemical manufacturer (e.g., Spectrum Chemical Mfg. Corp., Gardenia, CA; and Amend Drug and Chemical Co., Worthington, NJ); or (2) buy from a Canadian company (Methapharm Inc., Brantford, Ontario). Well, folks, not a heck of a lot has changed!

The products sold by the chemical manufacturers are still not approved by the United States Pharmacopoeia (USP) and are not approved for human use by the FDA. They come in bulk form and the laboratory must pay close attention to storage and weighing procedures. A somewhat recent article suggested that methacholine from chemical manufacturers and Provocholine, "are clinically and structurally similar and . . . the two agents may be used interchangeably in nonspecific bronchial provocation testing." (Sherman et al, Chest 1994;105:1095).

The product sold by Methapharm is approved by the USPand comes in a variety of pre-measured amounts. In order to purchase this product a laboratory will

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need to obtain an investigational new drug (IND) number from the FDA. [Call (301) 827-4537 and ask for an IND packet.] Methapharm has purchased the right to sell Provocholine (100 mg amounts) and is currently seeking the necessary FDA approvals. This approval process has been frustratingly lengthy for those who do not want to obtain the IND.

Putting the "obtaining-methacholine" issues aside, I wanted to tell you about two important publications that will likely be published in 1998 by the American Thoracic Society (ATS). The first is a pulmonary function laboratory procedure manual. It contains detailed chapters on the methacholine challenge and exercise challenge tests. The second publication is a methacholine challenge test guideline, which will update the 1980 guideline.

Little noticeable progress on obtaining methacholine has been made during the past two years. However, I remain optimistic that the FDA will approve Methapharm's request, making the process of obtaining methacholine much easier. Considerable work on new documents to help laboratories learn or refine procedures has taken place behind the scenes. So, I urge you to watch for and read the upcoming ATS publications. If you have any questions or concerns, contact me at my new phone number: (913) 599-4100. ■

Pulmonary Function Interpretation Strategies

by Michael Snow, RPFT

There are numerous approaches to evaluating pulmonary function test (PFT) results. PFTs present an interesting challenge when evaluating the test results. The interaction of multiple physiologic processes with structural changes can present a confusing picture. Simply comparing individual parameters to a statistically determined population norm can be misleading. For this reason, it is important to follow a rigorous methodology when reviewing results. This methodology should begin with a review of the testing objectives.

Before performing any tests, it is important to understand how the results will be used. The test results should answer a clinical question. Common clinical indications could include: evaluating response to interventions, trending chronically ill patients, ruling out specific conditions, developing a differential diagnosis, and evaluating disability. Understanding the purpose of the testing should determine which tests are appropriate. Any interpretation should make an explicit correlation with the clinical question.

The AARC has developed a series of Clinical Practice Guidelines (CPGs) for a variety of diagnostic procedures (1,2,3). These guidelines provide an excellent overview on clinical indications, contraindications, methodology considerations, and assessment of test quality. These CPGs should be incorporated into laboratory procedures. The American Thoracic Society (ATS) has published recommendations for spirometry and diffusing capacity. These guidelines not only provide recommendations for testing protocols, but also provide extensive review of the effect of different methodologies (4,5).

Any assessment methodology will only be as good as the selection of reference values and development of acceptable limits. It is beyond the scope of this paper to discuss reference values in any detail. However, it is important to note that the selected equation set should reflect similar testing methodologies and patient populations. Additionally, any potential reference set should be validated with normal subjects to assure a good match with your population. The importance of this validation cannot be overestimated. The ATS guideline provides an excellent review of reference values, as well as discussion on interpretative strategies (6).

Overall Interpretative Strategies

PFTs actually assess functional impairment in airflow, lung capacity, and diffusion of gases. These measurements may only indirectly reflect actual pathologic and physiologic changes. In fact, PFTinterpretation is actually a process of inference based on patterns of disturbance rather than direct measurement. Accordingly, it is very easy to over analyze test results and reach conclusions that cannot be supported by objective evidence. This is another reason why interpretation must address the clinical question being asked. A list of common tests and measured parameters is shown in Table 1.

Table 1: Common Pulmonary Function Tests

Spirometry	
FVC	Forced Vital Capacity
FEV1	Forced Expiratory Volume (one second)
FEV1/FVC	
FEFmax	Forced Expiratory Flow (Max)
FEF25-75%	Forced Expiratory Flow (between 25 and 75% of FVC)

Lung Volumes	
VC	Vital Capacity
IC	Inspiratory Capacity
ERV	Expiratory Reserve Volume
FRC	Functional Residual Capacity
TGV	Thoracic Gas Volume
RV	Residual Volume
TLC	Total Lung Capacity
RV/TLC	

Diffusing Capacity	
DLCO	Diffusion of the lung for carbon monoxide
VA	Alveolar Volume
DL/VA	

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The ATS guideline on selection of reference values also offers a thorough discussion of interpretative strategies for commonly used parameters. Accordingly, much of the discussion that follows will focus on patterns and subtle changes that can be detected when looking at the test results as a whole. These discussions are meant to be thought-provoking and add understanding to patterns of disturbance. If the test results are evaluated with a specific clinical question in mind, such as differential diagnosis in mixed disease, then subtle changes in the pattern of functional impairment can be revealing.

Interpretation of Individual Tests

Spirometry: The primary functional impairment in obstructive airways disease (OAD) is airflow reduction as a result of increased airway resistance. Spirometry provides a simple and portable method of assessing airflow. The FVC provides information regarding lung size, muscle strength, effort, and airway patency. The FEV1 reflects patient effort, elastic forces, and large airway patency. These two measurements and the FEV1/FVC ratio are by far the most common pulmonary tests. With excellent reproducibility, they provide a widely accepted trend measurement. FEFmax reflects similar information to FEV1, but with greatly increased variability. Spirometry answers more clinical questions than any other single test. It also has the virtue of being the most widely available test and is increasingly performed in physician offices.

Supplemental information from spirometry: There are other, more inferential uses of spirometry that can be used to confirm or rule out patterns of disturbance. Spirometry can be used to rule out significant restrictive lung disease (RLD) since a normal VC or FVC implies a normal TLC. However, a reduced FVC or VC can be due to many factors, including OAD, RLD, effort, and neuromuscular disease. Accordingly, while an FVC can be used to rule out significant RLD, it should not be used to diagnose RLD without a measurement of lung volumes.

Ratios can be useful tools to quantify patterns. However, factors affecting either or both components must be understood. Additionally, ratios should never be used without reviewing the absolute values of the constituents. However, with these caveats, ratios can be very useful in assessing patterns of disturbance. These approaches should be used with caution, but can offer valuable insight. There are two valuable ratios for using spirometry to assess RLD with or without concurrent OAD.

The ratio of FEFmax/FVC can provide a good indirect indication of restrictive processes such as increased elastic recoil or decreased compliance (7). Intuitively, this makes sense, since restrictive flow volume loop patterns tend to be narrower and disproportionately taller than normal or obstructive patterns. Normal relationships between FEFmax and FVC are generally 2:1. This is why the standard flow volume loop scaling is maintained at 2:1. There are many factors that can reduce this ratio, such as poor effort, increased airway resistance, and decreased elastic recoil. However, the only things that can increase it are incomplete exhalation during the FVC maneuver or increased elastic recoil. This ratio is useful in quantifying the visual perception of a narrow flow volume loop.

Another useful ratio to differentiate between RLD and OAD is the FEF25-75/FVC expressed as a percent of predicted (8). This ratio is helpful even when faced with combined disease. The FEF25-75% is strongly related to lung volume. To the extent that reference values reflect similar variability between the two measurements, you would expect the FEF25-75% and FVC percent of predicted to decrease proportionally. Dispro-portionate reductions in FVC relative to FEF25-75% would suggest a parenchymal type process since the reduction in FEF25-75% is greater than can be attributed to volume reduction. Since the FEF25-75% is generally more sensitive to increases in airway resistance than FVC, disproportionate decreases in FEF25-75% relative to FVC would suggest an obstructive process because the FEF25-75% reduction cannot be attributed to a volume reduction.

In other words, you would expect the FEF25-75% to decrease as the FVC decreases. If both values are 100% of predicted, the ratio would be 1.0. If they are both reduced proportionately, such as 50% of predicted, the ratio would still be 1.0. As the FVC disproportionately decreases, the ratio will increase. As this ratio exceeds 1.2-1.3, there is strong evidence to suggest an RLD or parenchymal type process. In an OAD process, the FEF25-75% should decrease before the FVC is affected. Accordingly, the ratio will decrease. For example, if the FEF25-75% is 60% of predicted while the FVC remains at 100% of predicted, the ratio will fall to 0.6. Ratios below 0.7-0.8 are strongly suggestive of increased resistance.

Lung Volumes

Measurement of lung volumes can be made either by body plethysmography or dilutional techniques. Plethysmography measures all compressible gas within the thoracic cage. Dilutional techniques measure the volume exchanged during the 3-5 minutes usually required for the measurement. Patients with severe OAD may require longer measurement times to complete the dilution. Most guidelines suggest stopping the test after seven minutes. The dilutional techniques can be either multiple or single breath and commonly involve either nitrogen washout or helium dilution. There are no significant differences between the use of helium or nitrogen for the dilution.

The effect of maldistribution means that dilutional methods will provide somewhat smaller measurements than a body plethysmograph, even in normal subjects. As OAD severity increases, this difference will increase. To some extent, the difference can be reduced if the multiple breath dilution is prolonged, but this is generally not practical. Single breath measurements will have an even greater difference from plethysmographic determinations since the time available for distribution is even less. Single breath measurements can significantly underestimate lung volume in the presence of airway obstruction but are useful for screening purposes in patients without significant OAD.

Comparing FRC or TLC measurements between plethysmographic and dilutional techniques provides an indication of maldistribution and a means of quantifying non-functional lung volume. The comparison of single breath VA with body plethysmograph measurement of TLC also provides an indication of maldistribution. In fact, comparison of the single breath VA to plethysmographic TLC may prove to be more clinically meaningful than multiple breath dilutions since it more closely approximates lung volume that is available during individual breaths than the volume available over several minutes. During lung volume reduction surgery, it is this non-functional volume that is targeted for removal.

Measurement of lung volumes usually involves determining FRC or TGV and calculating the TLC and RV by subtracting ERV or adding IC. The interpretation of lung volumes is, to some extent, dependent on the calculation method. Patients with significant OAD have difficulty sustaining consistent ERV maneuvers. By contrast, an IC maneuver may be much more reproducible. Even more

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important is whether the SVC, IC, and ERV were measured in conjunction with the determination of FRC or as a separate, unrelated measurement. If averages of FRC or TGV measurements are used with an SVC measurement determined many minutes earlier, the assumption that FRC has not changed may be incorrect. If the patient breathes at a higher point as a result of anxiety or fatigue, the previously measured ERV may no longer be appropriate. As a result, significant uncertainty is introduced into the interpretation of RV and TLC.

The basic assumption is that FRC reflects a reproducible lung volume and represents the point at which elastic recoil forces within the lung balance the tendency of the thoracic cage to expand. Other factors affecting FRC include anxiety and fatigue. With debilitated patients, fatigue may be an increasing factor. In most patients, some degree of anxiety is introduced by body plethysmograph testing. In either case, the assumption that FRC did not change may be compromised. For this reason, it is good practice to make an SVC measurement in association with the FRC or TGV determination.

An assessment of lung volumes is essential to confirm RLD or complete the assessment of OAD patterns of disturbance. With RLD, the TLC is reduced along with the FRC and RV. The RV/TLC ratio is usually normal. With OAD, the TLC may be either normal or increased depending on the type of OAD and the severity. In combined OAD and RLD, the presence of a normal TLC despite severe airway obstruction can be a significant finding. Some disease processes preferentially affect FRC and RV rather than TLC. Changes in lung volume associated with bronchodilator therapy can provide useful information since overinflation is associated with a perception of breathlessness and reducing overinflation can have a substantial clinical benefit for a patient.

Airway Resistance

Increased airway resistance is the definitive impairment associated with OAD. However, the interpretation of Raw is complex. Resistance is indirectly coupled with lung volume. As lung volume increases, and the airways are distended, Raw decreases. Conversely, significant, chronic increases in airway resistance will cause an increase in lung volume as the pulmonary system attempts to maintain a normal resistance. This is why many patients with significant OAD have normal or near normal Raw. This relationship makes Raw very difficult to interpret as a singular measurement. Much of the literature involving the clinical usefulness of Raw is misleading since it evaluates absolute values for Raw and does not account for volume compensation.

Measurements of SGaw and SRaw account for the lung volume at which the measurement was made. If the resistance is normal because the FRC has increased, then the SGaw will be reduced and the SRaw will be increased. Overinflation is a common finding in OAD, at least in part, as an attempt to compensate for the obstruction. Since lung volume is an intrinsic component of Sgaw, it tends to be more sensitive to peripheral resistances changes than FEV1. Combining these two measurements provides useful information on the site of airway obstruction. Additionally, the use of these volume adjusted measurements is particularly useful in pediatric measurements where resistances are normally high but associated with small lung volumes. A single reference value can be used for all age ranges.

SGaw and Raw measurements are particularly useful for evaluating response to bronchodilators or bronchoprovocation. Bronchial provocation protocols commonly use SGaw changes as a indicator of provocation. Increasingly, SGaw is being used as an indication of bronchodilator response as well. Patients' perceptions of breathlessness and response to medications are more strongly correlated with SGaw and Raw than with FEV1 (9,10,11).

Diffusing Capacity

Single breath diffusing capacity measurements are extremely sensitive but highly non-specific. Given the plethora of factors which can affect DLCO, it is an extremely complicated parameter to evaluate. The primary usefulness of the DLCO measurement is to assess changes in the alveolar capillary surface area and the permeability of the alveolar capillary membrane. Both of these functions are assessed indirectly by single breath determinations. It is commonly accepted that conditions which increase pulmonary capillary blood volume, such as pulmonary vascular congestion, will increase DLCO. Conversely, pulmonary emboli or other causes of decreased pulmonary capillary blood volume will reduce DLCO. Interstitial processes that thicken the alveolar-capillary membrane will decrease DLCO.

There are three primary parameters used to evaluate diffusion: DLCO, VA, and DL/VA. In general, reductions in lung volume will also reduce DLCO and VA proportionately, but not the DL/VA. Reductions in lung volumes resulting from poor patient effort will also reduce DLCO. It can be argued that proportional reductions in DLCO and VA do not constitute a diffusion defect. Strictly speaking, this would not reflect a transfer limitation but rather a lung volume limitation. To the extent that severe OAD affects distribution, the VA will increasingly differ from multiple breath measurements of TLC. Any reduction in VA will ultimately cause a corresponding decrease in DLCO. Whether or not this should be called a diffusion defect, absolute reductions in DLCO, without a concurrent reduction in DL/VA, are still an abnormal finding. Normal values for DL/VA do not rule out functional limitations since hypoxemia and breathlessness are correlated with DLCO not DL/VA (12).

It is generally accepted that reductions in DLCO and DL/VA are strongly associated with emphysema (13). Pulmonary vascular disease such as pulmonary emboli will also reduce DLCO and DL/VA. Restrictive processes such as extrapulmonary deformities and reduced force will reduce DLCO and VA proportionately, leaving DL/VA normal. Changes in diffusion are also very helpful in tracking changes associated with chemotherapy.

Utility of Testing Combinations

Pulmonary function testing usually consists of multiple functional tests, such as spirometry, lung volumes, and diffusing capacity. Increasingly, the tests to be performed are determined by therapist driven protocols. Frequently, only limited testing is performed. For example, spirometry can be used to answer specific questions, such as whether airway obstruction is present, and in trending chronically ill patients or evaluating response to bronchodilators. However, spirometry provides only a limited view of the patients' lung function.

Any interpretation develops more power when it is built upon the synergistic effect of test combinations. This permits evaluating the results from several perspectives. For example, spirometry is often inappropriately used to draw conclusions that should require additional testing. A common example is assessing RLD from a reduced FVC in combination with a normal FEV1/FVC ratio without measuring lung volumes. One of the most common errors in spirometry is the failure to completely exhale. This will result in reduced FVC and an elevated FEV1/FVC ratio but has nothing to do with restriction. For this reason, most guidelines suggest confirmation of a

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reduced TLC by a measurement of lung volumes.

Combining spirometry with airway resistance and specific conductance measurements increases the sensitivity and specificity for evaluating response to bronchodilators. Evaluating responsiveness with spirometry alone can miss a significant number of responders. Overinflation is frequently associated with severe OAD; lung volume measurements can confirm this pattern or emphasize the absence, which could indicate a combined OAD/RLD process. Diffusion defects are commonly a result of OAD but a disproportionately severe reduction in diffusing in the presence of mild OAD suggests some other pulmonary vascular explanation.

The value of test combinations becomes apparent when common patterns associated with functional impairment are reviewed. These patterns of disturbance are shown in Table 2. As can be seen from the table, spirometry alone cannot differentiate between many of the patterns. Only when viewing the results from the perspective of multiple tests can a true differential diagnosis be reached. The incremental time required to perform additional tests while the patient is already in the laboratory may be minimal when compared to the clinical benefit. However, when trending patients, single tests may be completely adequate. Again, the choice of diagnostic procedures must be made with a clear understanding of the clinical question. ■

Table 2: Patterns of Disturbance

Type	Flows FEV, FEFmax	Flows FEF25-75%	Raw	Sgaw	TLC	RV	Distrib	DLCO
Obstructive								
1. Bronchoconstrictive	Low	Low	High	Low	High	High	Abnormal	Norm/High
2. Compression	Low	Low	Norm	Low	High	High	Abnormal	Low
3. Upper Airway	Low	Norm	High	High	Norm	Norm	Norm	Norm
4. Small Airways	Normal	Low	Norm	Low	Norm	High	Variable	Norm
5. Mixed	Variable	Low	High	Low	High	High	Abnormal	Variable
Restrictive								
1. Parenchymal	Low	Low	Norm	Norm	Low	Low	Norm	Low
2. Reduced Force	Low	Low	Norm	Norm	Low	High	Variable	Norm
3. Extrapulmonary	Low	Low	Norm	Norm	Low	Variable	Norm	Norm
Combined OAD/RLD								
	Low	Low	High	Low	Norm	Norm	Variable	Variable

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Outstanding Section Member of the Quarter: Request for Nominations

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.

Mail or FAX a short (500 words or less) essay outlining your nominee's qualifications for the award to the Section Chair at the address/number listed on page 2 of this issue. Be sure to include your name, address, and phone number, along with that of your nominee. ■

FYI...

Methacholine challenge separates asthmatics from rhinitics

Response curves gleaned from methacholine challenge vary according to patient diagnosis, say researchers from the Universidad de Valencia in Spain. In a study of 107 mild asthmatics, 96 allergic rhinitics, and 25 healthy controls, they found that about 19% of asthmatics demonstrated a plateau effect, compared to 57% of the rhinitics and 92% of the controls. The plateau level expressed as FEV1 was significantly higher in asthmatics than in the other two groups, and asthmatics required a lower methacholine concentration to evoke a response. (Respir Med 1998;92:88-94)

Selected sample approach may be best

Analyzing both selected portions of a sputum sample (the more viscid portions of mucus) and the entire sample (including saliva) are both effective in diagnosing asthma, but European researchers have found that the selected route often produces better results. When they compared the two approaches in 18 asthmatics and eight healthy controls, they found that selected sputum samples contained a significantly higher percentage of viable nonsquamous cells, eosinophil cationic protein, and eosinophils than the entire samples. Entire samples, however, did contain significantly more neutrophils. (Am J Respir Crit Care Med 1998; 157:665-668)

Smallest airways respond to histamine challenge

Researchers from Johns Hopkins Asthma and Allergy Center in Baltimore, MD, have found that small peripheral airway reaction to histamine challenge is significantly greater in asthmatics than in healthy controls — though controls surprisingly showed responsiveness as well. The study involved measuring responsiveness in the smallest airways of 11 asymptomatic asthmatics and eight healthy controls with a fiberoptic bronchoscope and double-lumen catheter wedged in the anterior segment of the right upper lobe. (Am J Respir Crit Care Med 1998;157:447-452)

Measuring infants' response to bronchodilators

Do infants really respond to treatment with bronchodilators? Applying low-frequency forced oscillations in the respiratory system to assess airway resistance can measure the effects of inhaled bronchodilators in this population, say researchers from Perth, Australia. Their study of 13 infants with a history of recurrent wheeze and nine healthy controls found a fall in airway resistance after salbutamol administration but not after placebo when using this technique. (Am J Respir Crit Care Med 1998; 157:574-579)

Sedative helps mountain climbers deal with altitude during sleep

Mountain climbers who were given a low-dose sedative to help them sleep at high altitudes experienced a reduction in the number and severity of oxygen saturation changes during sleep and an overall improvement in the quality of their sleep. The medical officer with the British Mount Everest Medical Ex-pedition who tested climbers with the treatment and placebo also noted reduced periods of daytime sleepiness and higher daytime performance after the climbers had enjoyed a night of sedative-enhanced rest. (British Medical Journal 1998; 316:587-589)

Resource Panel Update

An updated version of our Resource Panel will be mailed soon and 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 page 2 of this issue. ■

___New Panel Member ___Returning Panel Member w/Changes

___Please drop my name from the panel

Name:_____

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TOPICS: *Resource 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**r