Lung Volume Reduction Surgery (LVRS) is a procedure that removes regions of emphysematous lungs through either a median sternotomy open approach or through video assisted thoracoscopic surgery (VATS). LVRS is thought to improve lung function in severe emphysema by two mechanisms: 1) By removing grossly overdistended lung regions, healthier but previously compressed regions are allowed to normally expand; 2) A smaller total lung volume allows the previously flattened diaphragm to return to a more normal configuration.

There has been much controversy about who would be the best candidates for this type of surgery. In small series published in the early-mid 1990s, substantial functional benefit was observed in some patients. Hypercarbia, homogeneous disease, and reduced DLCO seemed to predict poorer outcomes.

Because results were not consistent, the National Institutes of Health and Medicare joined together to develop a multicenter randomized controlled trial to compare LVRS to standard medical therapy, the National Emphysema Treatment Trial (NETT). Enrollment in NETT involved multiple tests of cardio-pulmonary function in an effort to find predictors of success. The goal was to follow patients for up to five years.

At the end of 2002, enrollment was completed with over 1200 emphysema patients being randomized. The efficacy results are not yet available but a subgroup with particularly poor outcomes from LVRS has been identified. Importantly, pulmonary function testing is critical in identifying this subgroup. Specifically, patients characterized by: FEV1 < 20% predicted AND either a DLCO <20% predicted OR homogeneous disease on chest CT have been shown to have a very high surgical mortality and should not be offered this procedure. Future analyses of the remaining patients are planned to hopefully identify other subgroups who may benefit.
Pulmonary Rehabilitation Entry Criteria

There is growing interest on the part of Medicare and other third party payers to reimburse pulmonary rehabilitation. To accomplish this, many Medicare intermediaries as well as insurance companies are trying to address criteria for appropriate patient selection. PFT labs are going to be at the forefront of this process.

Suggested criteria have been: FEV1 or FVC <60-80% predicted; DLCO <60-80% predicted, rest/exercise desaturation, exercise test demonstrating functional limitations from any cause. Comments from Registry members should be sent to the Newsletter editor via email at neil.macintyre@duke.edu.

The Annual ATS Meeting – PFT Lab Topics of Interest

The ATS meeting will be in Seattle this year. A number of topics have relevance to those operating pulmonary function laboratories:

May 17:

Post Graduate Course – PG 19, Lung function testing in infants and young children: practical and analytical aspects.

May 18:

Meet the professor – MP 420, Clinical forced oscillation.

Evening post grad – E3, Early detection of COPD: an opportunity to improve patient outcomes.

May 19:

Sunrise seminar – SS 110, Use of exercise testing to assess outcome in lung disease clinical trials.

Sunrise seminar – SS 116, Implementation of infant pulmonary function testing as an integral part of the pediatric pulmonary practice.

Sunrise seminar – SS 120, DLCO and KCO: how to adjust for lung volume and hemoglobin.

Meet the professor - MP 505, Bronchoprovocation testing in asthma.

May 20:

Sunrise seminar – SS 220, The MVV: why your PFT lab should measure it and how.
The Annual ATS Meeting – PFT Lab Topics of Interest cont’d

Clinical topics – C 3, Results of the National Emphysema Treatment Trial – pulmonary function outcomes in lung volume reduction surgery.

Meet the professor – MP 620, Clinical utility of exercise testing in cardiorespiratory disease.

May 21:

Sunrise seminar – SS 320, New spirometry parameters measured at 6 seconds improve diagnostic accuracy, decrease variability, and require less effort by patient.


Clinical topics – D73, Update on physiologic assessment in clinical practice: which test, when and which method is preferable and/or necessary to optimize patient diagnosis and management.

In addition to the above, a number of abstracts are expected that will relate to pulmonary function testing. Finally, the potential to have a breakfast gathering for Registry members exists. Please let the Newsletter editor (neil.macintyre@duke.edu) know by April 1 if you have interest in such a meeting.

Question from a Registry member

In a previous Newsletter, the issue of physician supervision was discussed. Medicare defines physician supervision at 3 levels: General – responsible for operations and policies/procedures but need not be present at all times. Direct – general supervision plus being immediately available (ie within the facility). Personal – general plus being present in the room. For a pulmonary testing laboratory, physician supervision is usually general although Medicare requires direct supervision for 94060, 94400, 94621, 94680, 94070, 94450, 94664, 94681, 94665 and personal supervision for 95070. Enforcement is only through the use of audits.

Pulmonary Function Testing in Intubated Mechanically Ventilated Patients

Several modern pulmonary function testing devices use a three-gas system to simultaneously measure lung volume, pulmonary capillary blood flow, and pulmonary diffusing capacity. This technique uses methane (CH4) as the inert insoluble gas for determining lung volume, acetylene (C2H2), a very soluble gas whose uptake is determined primarily by pulmonary capillary blood flow through ventilated regions, and carbon monoxide (CO), a gas avidly bound to hemoglobin and whose uptake is primarily determined by the pulmonary capillary blood volume in proximity to ventilated regions.
Pulmonary Function Testing in Intubated Mechanically Ventilated Patients cont’d

The simple dilution of CH4 allows for the calculation of the absolute lung volume at end inspiration and the slope of the C2H2 and the CO disappearance curve allows for the calculation of pulmonary capillary blood flow and diffusing capacity respectively. This technique has been used in pulmonary function labs for a number of years to measure functional residual capacity and carbon monoxide diffusing capacity. The acetylene channel is easily added with appropriate filtering systems and has been used at rest and during exercise in both healthy and diseased populations. Although no current interface exists with mechanical ventilators, this should not be a difficult to make.

In the mechanically ventilated patient, one can conceive of using these measurements in the following way. As PEEP is increased, end-expiratory lung volume (EELV) will increase accordingly. If recruitment is taking place, there should be increased exposure of pulmonary capillary blood thereby increasing pulmonary capillary blood flow and pulmonary diffusing capacity to ventilated regions accordingly. Conversely, if the increase in EELV is serving primarily to overdistend already recruited lung units, this increase will not be accompanied by additional increases in either pulmonary capillary blood flow or diffusing capacity. It must be emphasized that these ideas are only speculative at the present time as this technique has not been tried in mechanically ventilated patients. How it might compare with other techniques or whether it will impact outcome remains to be answered. Comments from Registry members on this or other PFT techniques in intubated mechanically ventilated patients are welcome via email at neil.macintyre@duke.edu.

Screening Spirometry in Asymptomatic Smokers?

The National Lung Health Education Project (NLHEP) has proposed that asymptomatic smokers be screened for obstructive lung disease (OAD). The idea is that if an abnormal FEV1/FVC ratio indicative of OAD is detected at an early stage, the progression to symptomatic COPD might be averted.

While conceptually attractive, this notion has been challenged because the only real intervention that is effective in early OAD is smoking cessation, something patients should be doing anyway – not just to prevent COPD but also cancer and heart disease. Clinical studies evaluating whether an abnormal spirogram facilitates smoking cessation have not been convincing. Indeed, some have suggested that a normal spirogram in a smoker might actually decrease the potential for smoking cessation. A nice review on this issue is Enright P and Crapo R, Controversies in the use of spirometry for early recognition and diagnosis of OAD in asymptomatic smokers. Clin Chest Med 2000;21:465-52. Comments from Registry members are always welcome via email at neil.macintyre@duke.edu.
Excerpts from the NIOSH Pulmonary Function Testing Newsletter (www.DrMckay.com)

What Causes the "Sawtooth" Pattern on a Flow Volume Tracing?

On occasion, inspection of the flow versus volume display may reveal small oscillations that give a "sawtooth" like appearance. Typically, these small fluctuations of flow appear at high flow rates and at high lung volumes. The appearance of the sawtooth pattern is not specific and may also be seen among subjects with obstructive sleep apnea, non-apneic snoring, thermal injury to the upper airways, respiratory muscle weakness, as well as vibration of soft tissue in the upper airway. Respiratory muscle weakness may also cause oscillations of flow (ie, the sawtooth like appearance) during inspiratory maneuvers. In addition, respiratory muscle weakness commonly shows a reduction in maximum expiratory and maximum inspiratory flows. The most obvious sign is a reduction in peak flow. In severe cases of expiratory weakness, an abrupt fall in flow may be seen just before residual volume is reached.

Should I Always Reject a Tracing with a Back Extrapolated Volume More Than 5%?

No. This answer often surprises our students, however, there are several situations where a tracing with an excessive Back Extrapolated Volume (BEV or Vext) should be accepted by the test operator. One example is among persons with small lung volumes. In these cases, the BEV expressed as a percent of the FVC may be 6.5%, however, on a volume basis it may be less than 150 ml. The current ATS standard states that a satisfactory start of test should have an extrapolated volume "less than 5% of the FVC or 0.15 L, whichever is greater". Another situation, although less common, is when a subject repeatedly provides tracings where the BEV% ranges between 4.8 and 5.2% of the FVC. In these cases, essentially all maneuvers from these tracings have similar starts. Yet, it is possible that the trials having BEV's less than 5% (ie, 4.8 to 4.9) represent poorer levels of inspiration. In these cases, it may be best to report the highest FVC and/or FEV1 from a trial having a BEV of 5.2%. When doing so, the operator should provide a written comment that adequately explains the situation and the reason for reporting values from a maneuver that does not meet ATS criteria. Remember, trials having excessive hesitating starts can produce erroneous values for FVC and/or FEV1, so you must be careful when accepting these maneuvers and always provide appropriate documentation.

FEV1 Rates of Decline:

Those of us who review spirometry tests for abnormal rates of decline are constantly reviewing the pulmonary literature for information that can help us identify normal from abnormal decline. Recently, investigators with the Lung Health Study conducted spirometry on a group of surviving participants eleven years after enrollment (Anthonisen NR, et. al., Am J Respir Crit Care Med. 2002;166:675-679). Results of the study showed that men who quit smoking had an FEV1 rate of decline of 30.2 ml/year. Women declined at 21.5 ml/year. Men who continued to smoke for the eleven-year period of time demonstrated an FEV1 decline of 66.1 ml/year. Women
who continued to smoke declined at 54.2 ml/year. While this study was not designed to provide data regarding significant declines caused by other exposures, such as in the workplace, the values provide additional information regarding how the lung responds to irritating agents.

"Spirometry UPDATE - REFRESHER" training course will be given by the University of Cincinnati on April 1, 2003.

Refresher training is recommended by the American Thoracic Society (ATS), the American Association of Occupational Health Nurses (AAOHN), the American College of Occupational and Environmental Medicine (ACOEM), and others. This special one day course will be given by Roy McKay, Ph.D. The course will review spirometry testing guidelines published by the ATS and will stress testing skills, technique, occupational surveillance needs, and interpretation techniques. Differences between ACOEM guidelines and "Office Spirometry" guidelines will be discussed. This course will also provide additional insight towards changes in lung function over time (ie, what is or is not a significant change?). Unlike initial spirometry training, this course does NOT have an exam. This is an excellent way to obtain answers to questions not foreseen during initial training and get continuing education credit. This course is approved for 7 Continuing Education contact hours for nurses. The University of Cincinnati an approved provider for Continuing Education credit. Information regarding this course including on-line registration is available by contacting: www.DrMcKay.com or, by calling 513/558-1234 between 8 am and 5 pm (Eastern Standard Time). Ask for Jeff.

NIOSH-Approved Spirometry Training:

This 3 day "initial" training course is designed for persons who will be conducting PFT's. This course is offered approximately five times per year and is designed to teach individuals how to correctly administer PFT's according to current standards and guidelines. This comprehensive course deals with all aspects of spirometry testing and uses a combination of lecture, hands-on training and small group problem solving sessions. Next course dates for NIOSH-approved Spirometry training are April 7-9, 2003. Information regarding this course including on-line registration is available by contacting: www.DrMcKay.com or, by calling 513/558-1234 between 8 am and 5 pm (Eastern Standard Time).