The Spirometry “Driver’s License”

As has been discussed in previous newsletters, the American Association for Respiratory Care (AARC) has been developing a credentialing process for spirometry technicians and this has been dubbed the spirometry “Driver’s License”. The process will involve two steps: 1) an on-line test developed in conjunction with the National Board for Respiratory Care; and 2) submission of 10 representative spirometry tracings. The on line test questions involve both technical questions as well as real-life scenarios. These have been developed with the assistance of the ATS pulmonary functions standards committee and should “go live” in 2010. The 10 submitted tracings will be reviewed by experienced technicians and physicians to assure ATS-ERS standards are being met. Specifics on how to apply for this credential will be forthcoming from the AARC in 2010.

ATS-ERS Clarifications

Since the publication of the most recent ATS-ERS standards on pulmonary function testing in 2005 (European Respiratory Journal – access at www.thoracic.org and proceed to ATS statements), a number of issues have arisen that needed clarification. The ATS-ERS task force has been developing a comprehensive document to address these and it should appear in print in 2010. Some of the more critical issues being addressed:

a) More specific criteria for the start and end of a spirometric forced vital capacity will be clarified.

b) The use of the largest vital capacity, regardless of whether it is a forced maneuver or a separately measured slow inspiratory or expiratory vital capacity should be used along with the largest FEV1 to calculate the FEV1/VC ratio for defining airflow obstruction.

c) Testing requirements for peak flow meter performance will be clarified.

d) The correction equation for DLCO gas concentrations in systems that remove water and CO2 from the gas sample had a small error that needed to be fixed.

e) The use of 95% confidence intervals to define lower limits of normal is re-emphasized for use in interpretive strategies.

AARC Conference on Pulmonary Function Testing

The AARC is considering a Respiratory Care Journal Conference devoted entirely to pulmonary function testing. The proceedings of this conference will be published in the Journal. Technical issues, interpretive issues, and regulatory issues will all be addressed. Registry members who have suggestions for specific topics are invited to submit those to: neil.macintyre@duke.edu
The Inspiratory and Expiratory Flow Pattern with Spirometry

In the April 2009 edition of Respiratory Care, three interesting articles addressing technical issues and interpretive strategies relating to maximal inspiratory and expiratory flow were published. In an accompanying editorial by Gregg Ruppel RRT entitled “The inspiratory flow volume curve: the neglected child of pulmonary diagnostics” (Resp Care 2009; 54:448), these implications of these papers were nicely summarized. Below are excerpts from this editorial:

“The past 30 years have seen many reports that described flow-volume patterns characteristic of specific upper and/or large airway abnormalities. For the most part those studies were observational and restricted to relatively small populations. And though the maximum expiratory flow-volume curve (the expiratory limb of the curve) is highly regarded as displaying a wealth of information about airway obstruction in its various manifestations, the inspiratory limb of the loop doesn’t get the same attention. Flattening of the inspiratory limb associated with vocal cord dysfunction and “saw-toothing” associated with obstructive sleep apnea are 2 widely recognized patterns in which the other limb assists in making a diagnosis. But, despite those associations, inspiratory flow patterns remain something of an afterthought in spirometric interpretation.

The fact that the maximum inspiratory flow is effort dependent may contribute to its status as a “second-class citizen” in pulmonary diagnostics. The utility of the flow-volume loop to graphically convey information concerning air flow into and out of the lungs seems compromised when a clinician has to look at multiple tracings to separate submaximal effort from real abnormal physiology. That there are few widely used quantitative variables to describe maximum inspiratory flow contributes to the dilemma. The ratio of the forced expiratory flow at 50% of the expired vital capacity to the forced inspiratory flow at 50% of the inspired vital capacity (FEF50%/FIF50%) is commonly used to quantify what the flow-volume loops shows us, but it suffers from the same shortcomings as most ratios: the absolute values of the numerator and denominator need to be considered as well.

This issue of RESPIRATORY CARE contains 3 papers that deal with flow-volume loops in general, and inspiratory flow in particular, from slightly different viewpoints. The paper by Sterner et al.
Inspiratory flow-volume curve evaluation for detecting upper-airway disease. Respir Care 2009;54(4):461-466. Retrospectively reviews flow-volume loops from a large number of subjects with essentially normal spirometry, to seek out abnormal inspiratory flow patterns. The intent was to determine if evaluation of the airway was performed and whether any large/upper-airway obstruction was found. Sterner et al document some of the difficulties encountered when pattern-recognition is the tool used to make the diagnosis. Patterns included “absent,” “truncated,” and “flattened.” They also sought to classify the repeatability of the patterns based on a comparison of 3 recorded loops. Nonrepeatability might seem to be a nonissue for an effort-dependent test, but the study considered the possibility that variability in the inspiratory flow pattern might be diagnostic (as in vocal cord dysfunction).

Perhaps the most important finding by Sterner et al10 was that almost 50% of the “abnormal” inspiratory loops were the result of poor effort, but were chosen because the software selected the flow-volume loop with the largest sum of forced vital capacity plus forced expiratory volume in the first second, without regard for the inspiratory effort that happened to accompany it. Sterner et al found that even when the inspiratory limb was repeatable and abnormal, only a small percentage of the subjects were evaluated further to rule out large/upper-airway obstruction. Interestingly, the study detected 8 subjects with vocal cord dysfunction, none of whom had consistently abnormal inspiratory flow. As might be expected, recalculation of the FEF50%/FIF50% with the inspiratory loop with the highest flow (rather than the one that accompanied the best expiratory effort) made a significant difference.

Another study in this issue, by Watson and co-workers, (Clinical and lung-function variables associated with vocal cord dysfunction. Respir Care 2009;54(4):467-473.) looked at whether flow-volume curves can detect vocal cord dysfunction. They studied a large number of subjects who had laryngoscopically determined vocal cord dysfunction, and they identified a “new” variable that seems to be related to vocal cord dysfunction: the ratio of the forced inspiratory flow at 25% of the inspired volume to the forced inspiratory flow at 75% of the inspired volume (FIF25%/FIF75%) taken from the best forced-vital-capacity effort. However, when their data were analyzed with the best inspiratory loop data, no spirometric variables were predictive of vocal cord dysfunction.

The third paper related to flow-volume loops in this issue,
from Modrykamien et al (Detection of upper airway obstruction with spirometry results and the flow-volume loop: a comparison of quantitative and visual inspection criteria. Respir Care 2009;54(4):474-479.) at the Cleveland Clinic, takes a broader approach in trying to determine what spirometric variables identify upper-airway obstruction. They included both visual and quantitative evaluation of flow-volume loops, including variables based on inspiratory flow. With evidence from bronchoscopy, computed tomography, and laryngoscopy they found that neither visual criteria nor individual quantitative measurements that suggested upper-airway obstruction were predictive for identifying abnormalities. A combination of the 4 quantitative criteria, assessed with receiver operating characteristic curves, appears to be slightly more sensitive in detecting upper-airway obstruction. Only 7.5% of the subjects in that study had upper-airway obstruction; and though a few had vocal cord paralysis, none had vocal cord dysfunction.

What findings from these 3 papers should concern pulmonary function technologists and clinicians who routinely perform spirometry that includes flow-volume loops? There are few recommendations from professional organizations regarding acceptability and repeatability of the maximum inspiratory effort, so practitioners need to be alert and use common sense when evaluating inspiratory maneuvers. Superimposing loops is an easy method for detecting important differences in flow, which are commonly the result of differences in patient effort. Carefully evaluate the FEF50%/FIF50% and pay attention to the absolute flows from which the ratio is derived. Check the software being used to determine how the “best” flow-volume curve is selected. Is it selected just by the effort that accompanied the best forced expiration? Most spirometers default to that value but allow the user to mix and match inspiratory and expiratory flow curves. Perhaps most importantly, all of the inspiratory loops should be reviewed in the context of the clinical question(s) being asked, keeping in mind that variability may be an important finding.”

Recent Publications on Pulmonary Function Testing

Pulmonary function testing in young children. Beydon N. Paediatric Respiratory Reviews. 10(4):208-13, 2009


