Debunking Myths in PFT's

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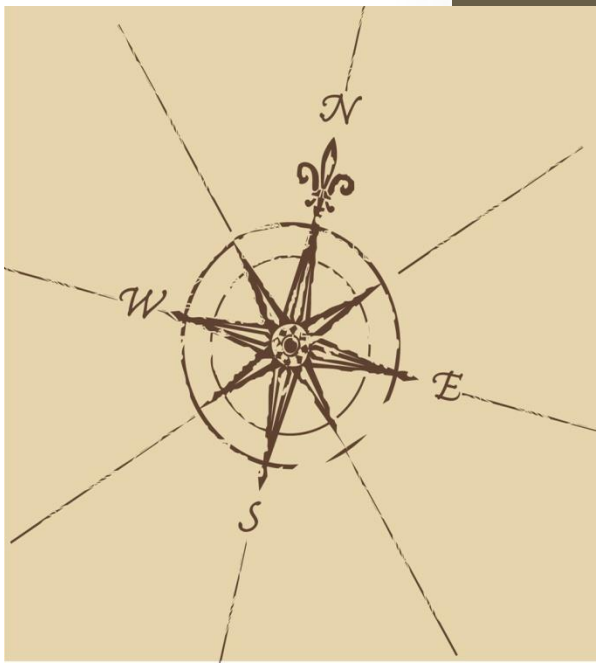
Learning Objectives

- Identify some myths, legends and half-truths in Pulmonary Function testing (PFTs).
- Reveal some of their sources
- Try to clarify the truth about them
- Have some fun in the process!!!
- Provide additional resources….



Despite The Facts That:

- Pulmonary Function Testing has only been around for about 50 Years

And

- Evidence-Based practice has (thankfully) gained a foothold

……..However, in that time, many myths and half-truths have emerged about PFTs……

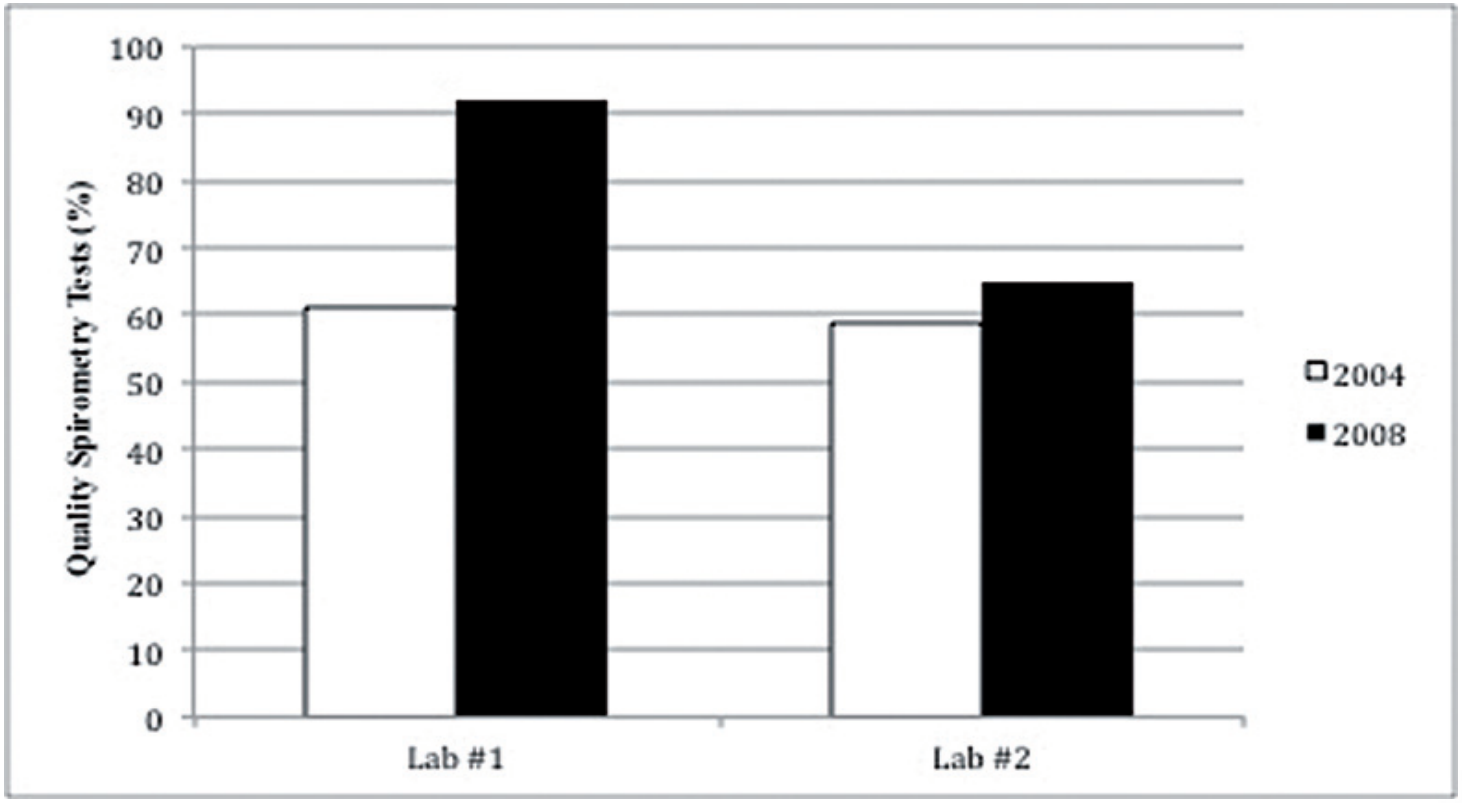
Caffeine Should be Withheld before PFTs

- As a member of the methylxanthine family, ***caffeine has been thought to possess bronchodilator properties.***
- Because of this, the 1999 American Thoracic Society (ATS) guideline for methacholine and exercise testing recommended that caffeine-containing products be withheld on the day of testing
- However, the 2005 ATS/European Respiratory Society guidelines do not prohibit caffeine prior to testing
- Yurach et al (2011) assessed the effect of caffeinated coffee on patients undergoing spirometry, methacholine challenge, and exhaled nitric oxide testing.
  - They found that ***a 16-ounce cup of coffee (~330 mg caffeine) had no effect on FEV1, methacholine responsiveness, or mean exhaled nitric oxide.***
  - ***Precluding patients from ingesting usual amounts of caffeine prior to pulmonary function testing may be unwarranted.***

Patients are Usually the Cause of Poor Quality Data

- Numerous studies have documented a high prevalence of poor-quality spirometry testing in both the pulmonary function laboratory and office settings.
- It is therefore not surprising that most technologists can be expected to blame poor patient effort and cooperation for poor test quality
- However, the literature clearly indicates that ***most patients, even children and the elderly, are capable of producing high-quality pulmonary function***
- ***data.***
- The ***key to higher quality pulmonary function data is technologist performance monitoring and feedback***
- In the Lung Health Study, Enright et al (1991) documented ***a reduction in spirometry test quality after initial technologist training, which improved with retraining, but could only be sustained with a program of on-going technologist performance.***

Training Pays Off!!!- The percentage of quality spirometry tests from two clinical laboratories. Baseline data from 2004 is compared to 2008 after lab #1 instituted an on-going technologist performance monitoring and feedback program.



Only High-quality Spirometry is Meaningful

- When spirometry quality is not perfect, ***many technologists reject sub-optimal tests to avoid reporting spurious data.***
- While the practice of discarding less-than-perfect spirometry data is well intentioned, it may ***frequently discard clinically useful data***.
- Using an A-B-C-D- F scoring strategy, Hankinson et al (2015) found that ***only quality scores of D or F affected test interpretation.***
- While we must always strive for maximum quality, technologists and physicians should ***exercise caution when discarding data.***

Technologists Must ***Scream*** at Patients to Obtain Quality Spirometry Results

- A typical lesson in spirometry testing includes stressing the importance of yelling or coaching loudly.
- This practice has ***no basis in science*** and in most situations is completely unnecessary.
- Yelling or screaming spirometry instructions can be ***frightening to children, annoying to teens, and less audible to those with hearing deficits.***
- ***Demonstrating the maneuver to the patient prior to testing and using suggestive body language during testing is more effective*** than yelling or screaming instructions at the patient.

FEF25–75% Aids in Overall PFT Interpretation

- The forced expiratory flow over the middle half of the vital capacity (FEF25–75%) is believed by many to be representative of small airways function.
- A common interpretation of a “low FEF25–75%” is that the test results are “***compatible with small airways disease***.”
- The problem with this interpretation is that ***FEF25–75% has a very wide normal range.***
- Indeed, after age 70 years, one can have an FEF25–75% less than 50% of predicted and still be above the 5th percentile
- Quanjer et al (2013) examined the impact of FEF25–75% on test interpretation, they (i.e., normal FVC, FEV1, and FEV1/FVC) was only 2.75%. ***found the incidence of FEF25–75% falling below the lower limit of normal as an isolated finding***
- ***FEF25–75% adds little to the information provided by FVC, FEV1, and FEV1/FVC.***

DLCO/VA Can Normalize an Abnormal DLCO

- While it is undeniable that DLCO and lung volume are directly related, this relationship is both complicated and difficult to predict .
- A common ***mistake is to declare an abnormal DLCO normal if the DLCO/VA is within the normal range***.
- This implies that the DLCO is low due exclusively to a lack of lung volume, not alveolar–capillary pathology.
- A study by Pastre et al (2015) shows ***that DLCO/VA can often be within the normal range even in patients with significant parenchymal lung disease***.
- Therefore, ***DLCO/VA is not a reliable parameter for inverse modeling (i.e., predicting structure from function)***.

DLCO “Original” Equipment

- DLCO Simulator

Hans Rudolph 5560 Series DL,CO simulator.

Review Point: Which of the following Conditions Increase DLCO

- Increased Hb (polycythemia)
- Decreased Intrathoracic pressure (resistance breathing)
- Exercise
- Supine position

- Answer: All of the Above

Review--DLCO Interpretation

- Normal value: 25 mL CO/min/mm Hg (STDP)
- It varies directly with the patient's lung volumes
- Increases during exercise
- Decrease in restrictive lung diseases and emphysema
- DLCO is directly related to lung volumes (V_A)
- Normal DL/V_A ratio is 4-5 mL CO

Review--DLCO Interpretation

- Decreased DLCO values
  - Caused by:
    - Small lung volume (e.g., lung resection)
    - Diffusion defects
  - Pulmonary fibrosis
  - Emphysema
  - Pulmonary vascular and cardiovascular diseases
  - Anemia
  - Renal failure
  - Marijuana and/or cigarette smoking

80% of Predicted is a Reliable Lower Limit of Normal

- The so-called "80% of predicted" rule declares any value below 80% as abnormal and vice versa.
- Sobol and Sobol (1979) commented that ***"nowhere else in medicine is such a naïve view taken of the limit of normal."***
- The ***"80% rule" is statistically invalid*** for a number of reasons.
  - Firstly, the normal ranges for different PFT values are not identical.
  - The normal variance for any value is affected by age, race, and gender.
- Quanjer et al (2011) found that ***using the "80% of predicted" rule and 0.70 as the LLN for FEV1/FVC misclassified >20% of patients***.
- Wesolowski et al (2016) documented that ***14% of surgical lung cancer patients had pulmonary function values which were both <80% of predicted and above the LLN.***
- ***PFT data should not be interpreted using 80% of predicted as the LLN***.

Review--What is a methacholine challenge test?

- The patient blows forcefully into a spirometer.
- The patient will inhale a mist that contains methacholine.
- The patient will again blow forcefully again into a spirometer.
- This process will be repeated using increasing doses.
- If the patient has asthma, the spirometry values will drop by at least 20% during the test.
- The patient will then receive a bronchodilator medication at the end of the test (or when needed) to reverse the effects.
- The Results:
  - Evaluate lung function and the reactivity (narrowing or tightening) of your airways.
  - Help diagnose and monitor asthma.

A Positive Methacholine Challenge Confirms Asthma

- Methacholine challenge tests (MCT) are performed to test for the presence or absence of airway hyper-responsiveness (AHR).
- AHR is clearly a feature of asthma; ***however, AHR is not exclusive to asthma.***
- For example, Leone et al (1997) found that ***46% of patients with non-allergic rhinitis with eosinophilia syndrome and no respiratory symptoms demonstrated AHR to methacholine.***
- AHR is also a feature of COPD, sarcoidosis, and allergic rhinitis.
- In addition, some subjects with no signs or symptoms of asthma demonstrate AHR to methacholine (asymptomatic AHR).

A Negative Methacholine Challenge Excludes Asthma

- As mentioned above, MCTs are performed to test for the presence or absence of AHR.
- A ***lack of demonstrable AHR in response to MCT may significantly decrease the post-test probability of asthma***.
- However, ***the sensitivity of MCT is not 100%.***
- Anderson et al (2009) found that ***45% of children with a positive exercise challenge had a negative methacholine challenge***.
- In a study of elite athletes, the ***sensitivity of MCT to identify a positive response to eucapnic voluntary hyperventilation was only 36%.***
- The ***failure of MCT to identify asthma with perfect sensitivity is multi-factorial*** including both physiologic and technological considerations.
- In addition, the response to methacholine may be affected by seasonal variations in AHR.

A Negative Exercise Challenge Test Excludes Exercise-induced Bronchospasm

- Exercise challenge tests are commonly performed to identify or exclude exercise-induced bronchospasm.
- An ***obvious limitation of exercise challenge tests is that they are not performed under the same circumstances*** as those from where the patient's symptoms originate.
- This is perhaps no more true than patients involved in cold-weather athletics.
- Rundell et al (2000) performed field exercise challenge testing in elite cold-weather athletes; ***78% of athletes with a positive field exercise challenge test had a negative exercise challenge test in a clinical laboratory.***
- ***Differences between field and laboratory testing may be due to differences in exercise pattern and intensity as well as environmental factors*** such as ambient humidity and air quality.

Normal Spirometry Excludes Emphysema

- It has become known that COPD has many phenotypes.
- Patients with some of these phenotypes may have normal spirometry.
- For example, the COPDGene investigators found that ***24% of current or former smokers with normal spirometry and a GOLD 0 classification had computed tomography evidence of emphysema.***
- Another poorly appreciated syndrome associated with cigarette smoking is ***combined pulmonary fibrosis emphysema (CPFE).***
- Patients with CPFE have radiologic evidence of upper lobe emphysema and lower lobe fibrosis.
- Patients with CPFE typically have a low diffusing capacity, elevated alveolar–arterial oxygen gradient, but normal spirometry and lung volumes.
- ***Relying solely on spirometry to diagnose or exclude disease in symptomatic smokers can be expected to misdiagnose many patients with emphysema and CPFE.***

Delta FEV1 Effectively Assesses Bronchodilator Response in COPD

- ΔFEV1 to assess bronchodilator response/benefit in COPD patients.
- While patients with COPD can demonstrate significant increases in FEV1 after bronchodilator, many do not.
- A not so uncommon yet mistaken conclusion is that an insignificant ΔFEV1 indicates a lack of therapeutic efficacy.
- However, ***it is important to keep in mind that COPD patients seek medical care for dyspnea, not a recalcitrant FEV1.***
- Bronchodilators reduce dyspnea on exertion by reducing the rate of dynamic hyperinflation, which may not be accompanied by an arbitrarily agreed upon "significant" ΔFEV1.
- O'Donnell et al (2001) studied acute bronchodilator response in COPD patients who ***did not show improvement in FEV1 but di demonstrate a significant reduction in hyperinflation*** (i.e., increased inspiratory capacity, reduced residual volume) despite no change in FEV1.
- ***Judging bronchodilator response in COPD patients solely on ΔFEV1 may lead to an under-appreciation of clinically important improvements***.

Take Home Points

- ***Evidence-based medicine has revolutionized both diagnostics and therapeutics.***
- ***However, the age of evidence-based medicine has not made PFT laboratories immune from policies, procedures, and mistaken beliefs borne of myth and unproven theory.***
- ***Indeed, pulmonary function guidelines contain recommendations based on both scientific data and unproven expert opinions.***
- ***Pulmonary function technologists should be on the forefront of incorporating evidence-based practices in pulmonary function laboratories.***

Selected Sources & References

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