LUNG FUNCTION IN HEALTH AND DISEASE: SPIROMETRY

SPIROMETRY

- Spirometry is a widely used, effort depended basic lung function test
- Assess the lung performance
- Assess physiological parameters; lung volumes, capacities & flow rate
- Differentiate between the obstructive and restrictive lung conditions
- Play a critical role in the diagnosis, differentiation and management of respiratory illness.

Ruppel, Res Care Clin N Am 1997;
Pierce William, Aus Fam Phy J , 2005

PHYSIOLOGICAL CONDITIONS AND SPIROMETRY

Physiology conditions:

- ❑ **Age**
- ❑ **Gender**
- ❑ **Height**
- ❑ **Weight**
- ❑ **Ethnic group**
- ❑ **Pregnancy**

Cotes, 1995

INDICATIONS OF SPIROMETRY

Based on clinical features / abnormal lab tests

Symptoms: Dsypnea, cough, sputum production, chest pain

Signs: Cyanosis, clubbing, chest deformity, diminished chest expansion, hyperinflation, diminished breath sounds, Prolongation of expiratory phase & crackles

Arterial blood gas analysis: Hypoxemia, hypercapnia

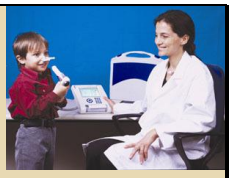
Abnormal chest X Ray:

Cotes, 1995

Hypoxemic respiratory failure (type I) is characterized by an arterial oxygen tension ($P_a O_2$) lower than 60 mm Hg with a normal or low arterial carbon dioxide tension ($P_a CO_2$). This is the most common form of respiratory failure, and it can be associated with virtually all acute diseases of the lung, which generally involve fluid filling or collapse of alveolar units. Some examples of type I respiratory failure are pulmonary edema, pneumonia, and pulmonary hemorrhage.

Hypercapnic respiratory failure (type II) is characterized by a $PaCO_2$ higher than 50 mm Hg. Hypoxemia is common in patients with hypercapnic respiratory failure who are breathing room air. The pH depends on the level of bicarbonate, which, in turn, is dependent on the duration of hypercapnia. Common etiologies include drug overdose, neuromuscular disease, chest wall abnormalities, and severe airway disorders (eg, asthma and chronic obstructive pulmonary disease [COPD]).

INDICATIONS OF SPIROMETRY



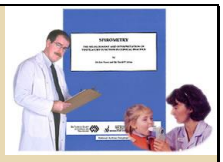
Describe the course of diseases affecting PFTs

Neuromuscular diseases: Gillian Barre Syndrome, Myasthenia gravis

Pulmonary diseases: Obstructive airway diseases, Interstitial lung diseases

Adverse reactions: Drugs with known pulmonary toxicity [Pulmonary fibrosis]

INDICATIONS OF SPIROMETRY



Monitoring indications

To assess the therapeutic interventions:

Bronchodilator therapy

Steroid treatment for asthma

Chronic obstructive lung disease

Interstitial lung disease

Steroid medicines (corticosteroids) to be inhaled come in a form for a metered-dose inhaler (MDI) or a dry powder inhaler (DPI).

How It Works

Steroid medicines decrease inflammation in the airways (reducing swelling and mucus production), making breathing easier.

Why It Is Used

Oral steroid medicines may be used to treat chronic obstructive pulmonary disease (COPD) when symptoms rapidly get worse especially when there is increased mucus production.

Inhaled steroid medicines may be used to treat stable symptoms of COPD or symptoms that are slowly getting worse. They may decrease the number of COPD exacerbations in people with severe COPD, particularly those with chronic bronchitis and frequent exacerbations.

These medicines may be useful for people who have asthma as a component of their disease.

INDICATIONS OF SPIROMETRY

PRE OPERATIVE INDICATIONS

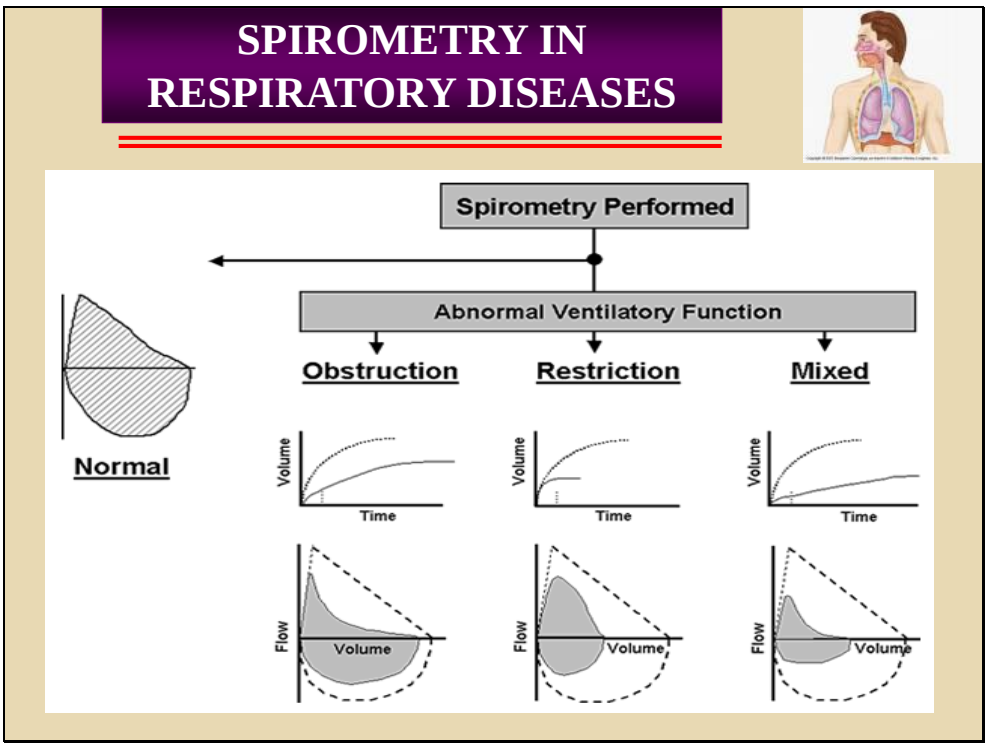
To determine the suitability for and management during and after anesthesia

To assess the risk for surgical procedures known to affect lung function

Cotes 1995; ACCP Chest 2003; Regli et al., Anaesthesia, 2006

EG.
Residual volume (RV) is the amount of air remaining in the lungs after a maximal expiration (normally 500mls). In patients with obstructive lung diseases where there is incomplete emptying of the lungs and air trapping, RV may be significantly increased. Patients with high RV who require surgery and mechanical ventilation require high peri-operative inflation pressures. This increases the risk of barotrauma, pneumothorax, infection and reduced venous return due to high intra thoracic pressures

A vital capacity is an important preoperative assessment tool. Significant reductions in vital capacity indicates that the patient is at a higher risk for postoperative respiratory complications. This is because vital capacity reflects the patient's ability to take a deep breath, to cough, and to clear the airways of excess secretions.



Obstructive lung disease

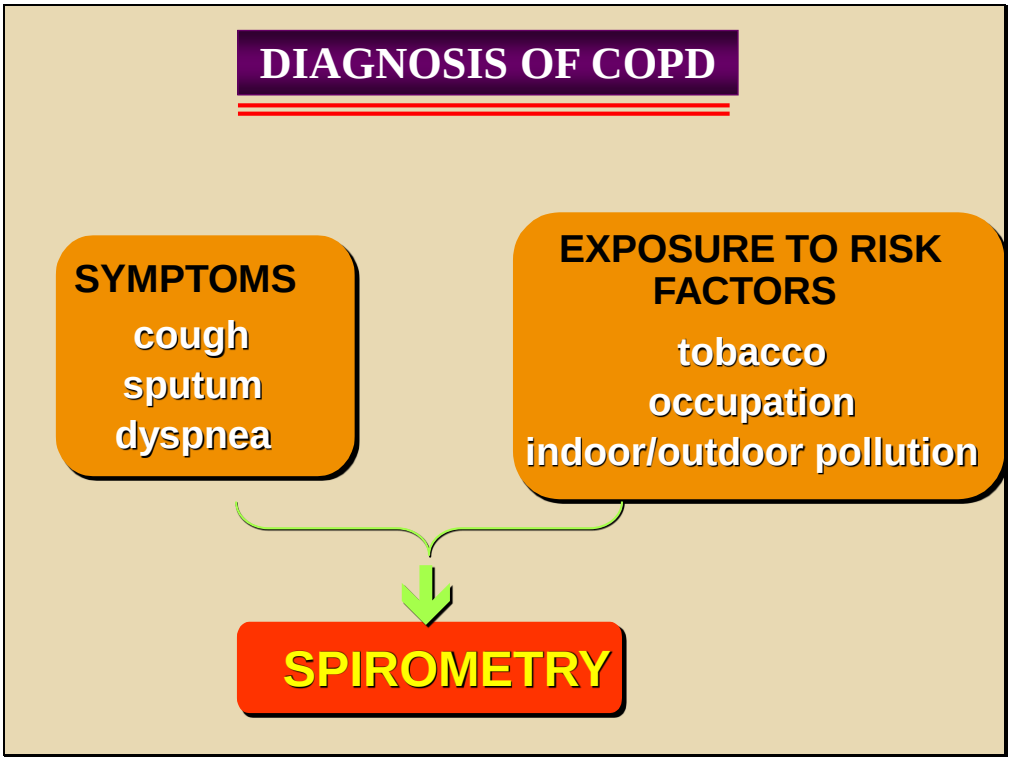
When a forced expiration is performed with severely obstructed airways, there may be more collapse of the airways, giving a greater concave appearance

An FEV1/FVC of <0.7 (70%) is diagnostic of air flow obstruction and confirms obstructive disease . However, a lower than normal FEV1/FVC may not be abnormal for an asymptomatic older person.

The presence of irreversible or limited airflow obstruction should be confirmed by performing post-bronchodilator spirometry.

Restrictive lung disease

Restrictive lung disease is caused by extrapulmonary conditions affecting movement of the chest wall and intrapulmonary conditions affecting lung elasticity . Both affect inflation of the lungs and cause lung volumes to be reduced, but the calibre of the airways is unaffected. The volume/time graph has a shape similar to normal, but with a lower FEV1 and a lower FVC . The flow/volume graph has a squashed appearance . Restrictive disorders have a near-normal or higher than normal FEV1/FVC, but both the FEV1 and FVC are reduced proportionally.



Chronic obstructive pulmonary disease (**COPD**): is a type of obstructive lung disease characterized by chronically poor airflow. It typically worsens over time. The main symptoms include shortness of breath, cough, and sputum production. Most people with **chronic bronchitis** have COPD

It is refers to a group of lung diseases that block airflow and make breathing difficult. Emphysema and chronic bronchitis are the two most common conditions that make up COPD. Chronic bronchitis is an inflammation of the lining of your bronchial tubes, which carry air to and from your lungs. Emphysema occurs when the air sacs (alveoli) at the end of the smallest air passages (bronchioles) in the lungs are gradually destroyed.

Dyspnea or **dyspnoea**, **shortness of breath** or **breathlessness** is the feeling or feelings associated with impaired breathing.
Dyspnea is a normal symptom of heavy exertion but becomes pathological if it occurs in unexpected sit

SMOKERS AND SPIROMETRY

Smoker & Non Smoker:

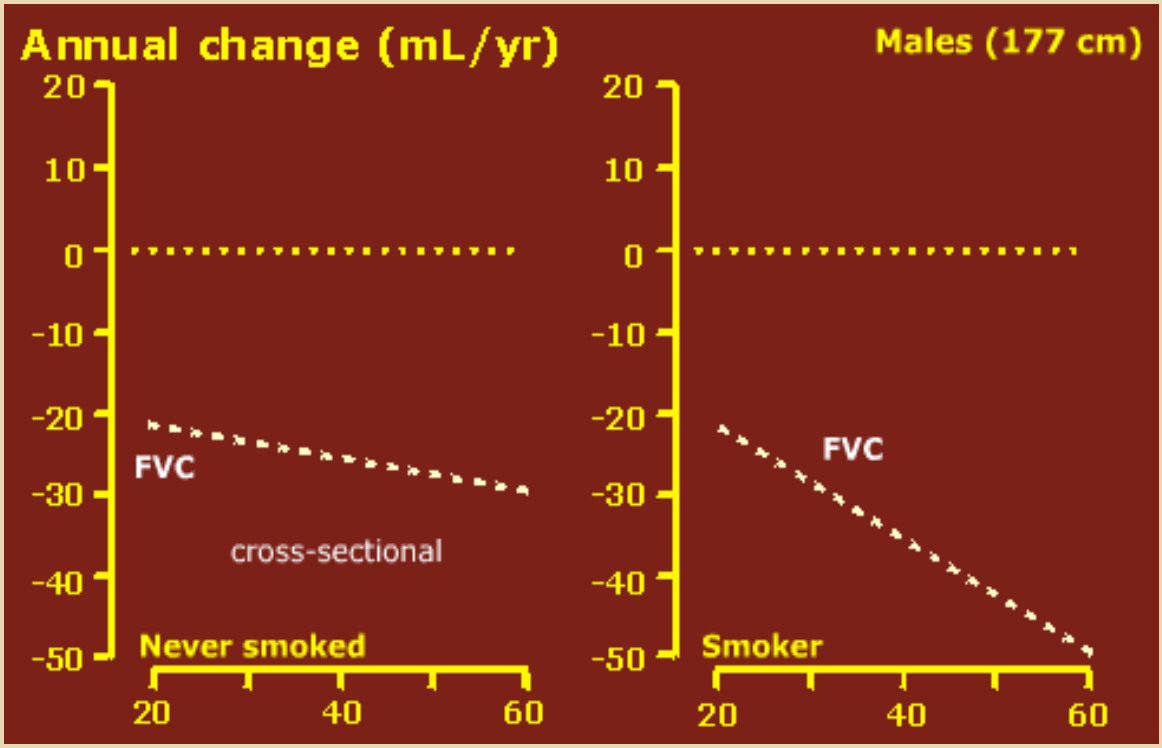
Non Smoker: In normal healthy non smoker subject after the age of 30 the expected decline in Lung function parameter [FEV1] is 25–30 ml/ year

Smoker: The average rate of decline of lung function in smokers as measured by Forced Expiratory Volume in 1 sec [FEV1] is 60-70 ml / year

Davis et al., Diabetes Care, 2004

Smoking can damage the lungs and affect lung capacity, making it difficult to breathe. The lungs contain tiny air sacs called alveoli where oxygen is transferred from inhaled air to the blood, When these air sacs are damaged by smoking, the lungs and heart must work harder to take in oxygen, which can lead to shortness of breath,

SMOKERS AND SPIROMETRY



SMOKERS AND SPIROMETRY