MEDICINE
KING SAUD UNIVERSITY

Physiology Team 436

Revised by
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Lung Function in Health and Disease

RESPIRATORY BLOCK

Red: very important.
Green: Doctor's notes.
Pink: formulas.
Yellow: numbers.
Gray: notes and explanation.

Physiology Team 436 – Respiratory Block Lecture 4

Lecture: If work is intended for initial studying.
Review: If work is intended for revision.

STUDY SMART

ملاحظة مهمة:
الفرق بين سلايدات العيال والبنات كبير جدا. ركزوا على المشترك بينهم أهم شي.

Types of Lung Function Tests

Spirometry	It is the measurement of the speed and the amount of air that can be exhaled and inhaled. There are two types: 1. Static (for lung volumes) and 2. dynamic (for FEV1 and flow rate)
Body Plethysmography test:	• The patient is required to sit in an airtight chamber that resembles a small telephone booth. Inside the chamber is an affixed spirometer, which is used to determine the flow properties of the patient.
Cardiopulmonary "Exercise" Stress Testing	Used for evaluation of dyspnea that is out of proportion to findings on static pulmonary function tests (to differentiate between cardiac and chest problems)
Diffusing Capacity of Lung for Carbon Monoxide	• To evaluate the presence of possible parenchymal lung disease
Pulse Oximetry	• The principle is measurement of O2 saturation by spectrophotometry
Specific Inhalation Challenge (SIC)	A diagnosis tool to assess airway responsiveness to "sensitizing" substances as opposed to nonspecific stimuli such as pharmacological agents (i.e. histamine, methacholine), cold air and exercise. Subjects are exposed to a suspected occupational agent in a controlled way under close supervision in a hospital laboratory. The specific inhalation challenges has been considered as the gold standard in confirming the diagnosis of occupational asthma.

Physiological Conditions Affecting Lung Functions

- **Age**: In newborns it is decreased because their lungs are not fully developed, and in old age it also decreases. (Reaches its peak at the age of 35, then it starts on decreasing.)
- **Gender**: In females it is 20%-25% less than males because females have greater body fat mass unlike males; who have greater muscle body mass.
- **Height**: Increased height will result in longer chest cavity thus it increases lung volume.
- **Weight**: Excessive fat in the abdomen will put pressure on the diaphragm so it will limit the lung function.
- **Ethnic group**

الاختلافات العرقية يعني مثلا غالبا الافريقين والاوربيين يكونون طوال وبنيتهم الجسدية كبيرة والاسيويين بنتيهم صغيرة

- **Pregnancy**: Enlarged uterus will also put pressure on the diaphragm.
- **Posture**
- **Diurnal, seasonal, or climate variation**
- **Customary activity**
- **Geographical location**

Greater in large and athletic people than in small and asthenic people.

Spirometry

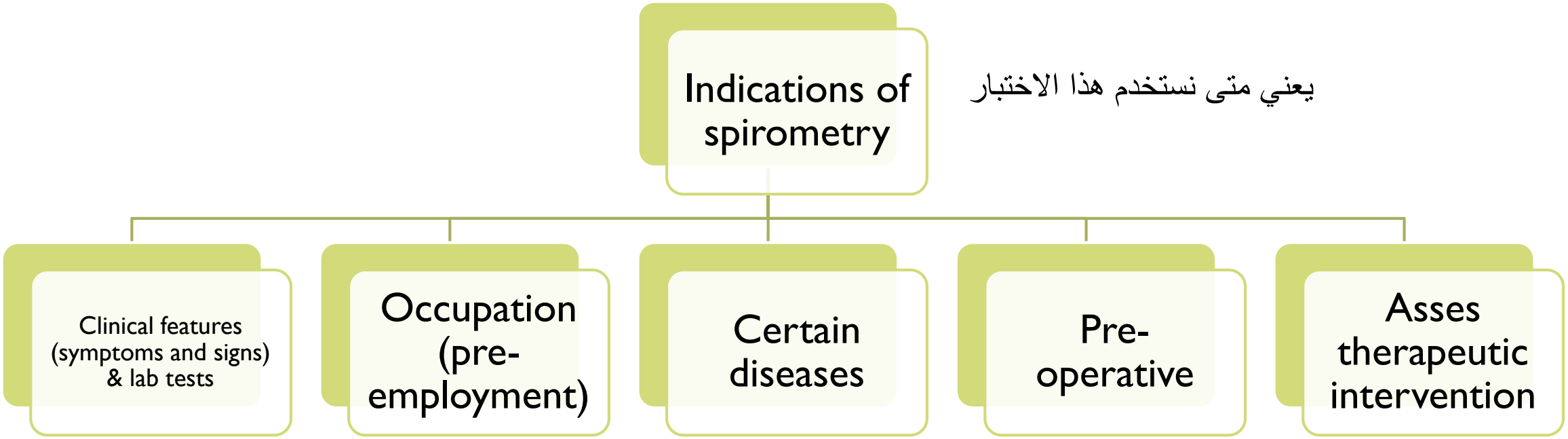
- Spirometry is a method to record volume movement of air into and out of the lungs.

1. Widely used. 2. Effort dependent (If the patient was not compliant (coughing or moving) the test will not be precise) basic lung function test.

Spirometry is a simple most commonly used test to:	1- Assess the lung performance.
	2- Measure the physiological parameters: Lung volumes, Capacities, Flow rate.
	3- Differentiate between the obstructive and restrictive lung conditions.
	4- Play a critical role in the diagnosis, differentiation and management of respiratory diseases. نعطي المريض دواء وبعد فترة نعيد له الاختبار اذا تحسن معناته الدواء فعال إذا لا نغير العلاج

Overview; Indications of Spirometry

How does it benefit diagnosing?



Indications of Spirometry

- Based on clinical features / abnormal lab tests (the doctor suggests spirometry examination according to):

1. Symptoms

- Dyspnea ضيق التنفس
- Cough
- Sputum -لعاب) (بلغم production
- Or phlegm production
- Chest pain

2. Signs

- Cyanosis, ازرقاق للثة وأطراف الأصابع
- Clubbing *see in picture
- Chest deformity (like: kyphosis)
- Diminished chest expansion → Hyperinflation
- Diminished breath sounds → Prolongation of expiratory phase & crackles

3. Arterial Blood Gas Analysis

- Hypoxemia (low O_2 in blood)
- Hypercapnia (high CO_2 in blood)

^= Low Ph (acid)

4. Abnormal Chest X Ray.

NOTE:
In Acute chest pain avoid spirometry because it requires deep inspiration & deep expiration. deep respiration exaggerates (worsens) the problem

Diminished chest expansion (When you ask the patient to take deep breathe, it be limited movement)

-Hyperinflation (تضخم) نشاهده بأشعة اكس

-Diminished breath sounds صوت التنفس يكون محدود (بسبب بلموري اديما أو سوائل في التشست أو نومونيا) نحس بالصوت هذا لما نختبر بأصابعنا "percussion"

Prolongation of expiratory phase & crackles (Who have fluid in the chest)

Symptoms are what the patient says, signs are what the doctor notices.

Cont.

Occupational Settings:

Pre employment (spirometry must be a pre-employment test).

Periodic lung function examination for workers exposed to toxic substances including dust and fumes in industrial sectors such as:

Cement / Asbestoses

Welding / Wood / Steel

Flour / Coal mine / Oil

الناس الي يشتغلون في المصانع أو المناجم
أو.... لازم نسويلهم الاختبار بشكل دوري

ONLY IN MALES' SLIDES

- To detect respiratory disease in patients presenting with symptoms of breathlessness, and to distinguish respiratory from cardiac disease. إذا جاك مريض فيه ألم في الصدر وصعوبة تنفس ووو... ونبغى نعرف إذا المشكلة في القلب أو الجهاز التنفسي نسوي هذا الاختبار
- To diagnose or manage asthma (which is an obstructive disease).
- To diagnose and differentiate between obstructive and restrictive lung diseases.

Cont.

- **Describe the course of diseases affecting PFT*s:** نتابع تطور تحسن وتدهور بعض الأمراض
  - Neuromuscular diseases: Gillian Barre Syndrome, Myasthenia gravis
  - Pulmonary diseases: Obstructive airway diseases, Interstitial lung diseases
  - Adverse reactions: Drugs with known pulmonary toxicity [Pulmonary fibrosis]

- **Monitoring indications (to assess the therapeutic interventions):**

(To measure the response to treatment of conditions which spirometry is used in the detection of e.g. COPD, etc..)

- Bronchodilator therapy
- Steroid treatment for asthma

Used on Chronic obstructive lung disease (like emphysema) and Interstitial (restrictive) lung disease

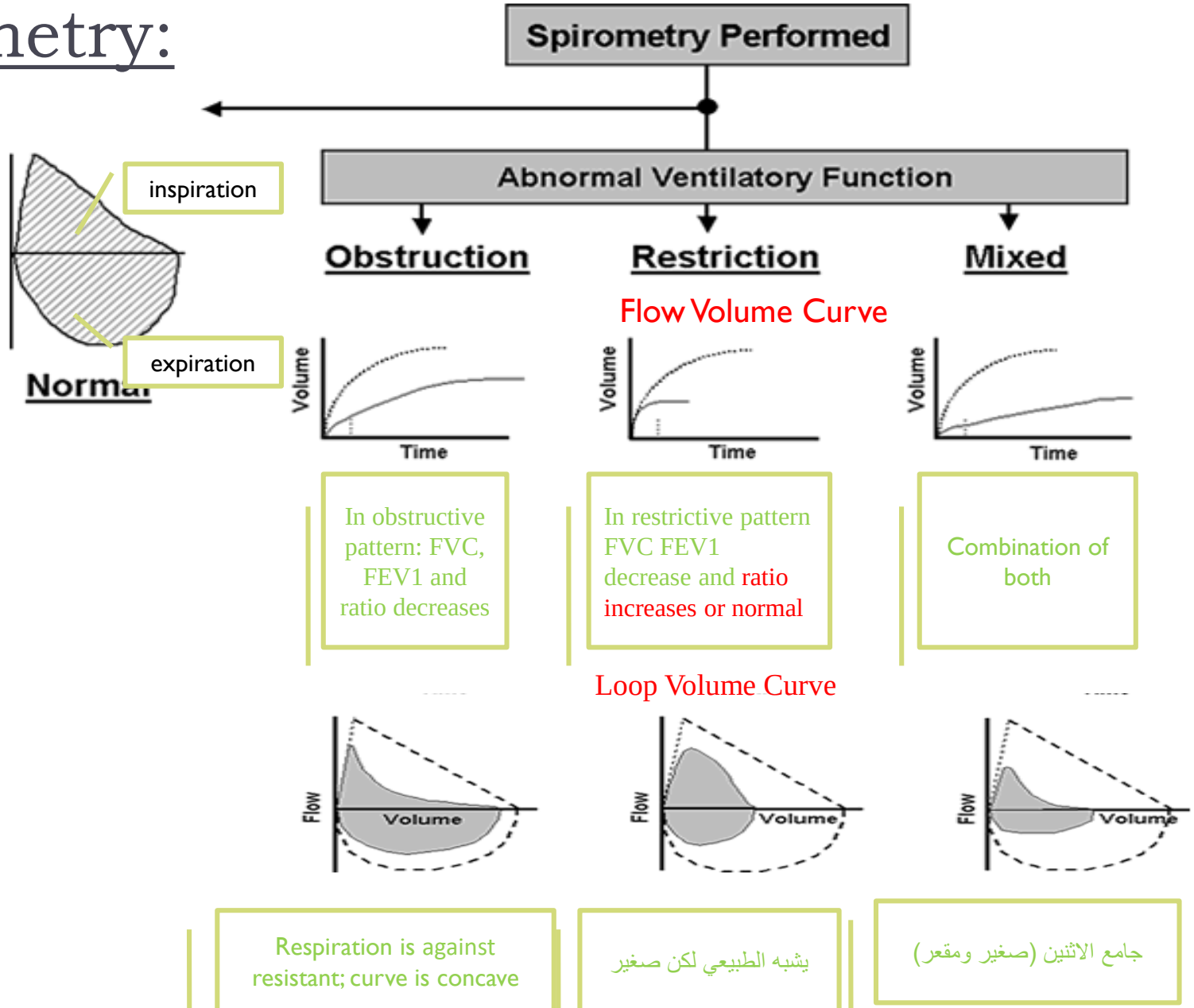
نشوف إذا نفع العلاج أو لا ؟
نعطي المريض دواء ولما ينتهي الكورس نعيد له الاختبار اذا تحسن معناته الدواء فعال إذا لا نغير العلاج

- **Pre operative indications** (to conduct pre-operative risk assessment before anesthesia):
  To determine the suitability of patients for anesthesia **during and after anesthesia** (because anesthesia may cause chest complications after surgery).
  To assess the risk for surgical procedures known to affect lung function.

بعض التعقيدات اللي تصير بعد العمليات الجراحية تكون بسبب يتعلق بالتخدير , وحتى الشخص الصحي يعاني بعد العملية من ألم في الصدر , فالأشخاص اللي يعانون أصلاً من مشاكل في الرئة ممكن هالشيء يؤدي عندهم للوفاة, وعشان كذا دائماً دكتور التخدير يشوف المريض ويعاينه ويفحصه قبل العملية

*PFT= Pulmonary Function Test

Assessment of Spirometry:

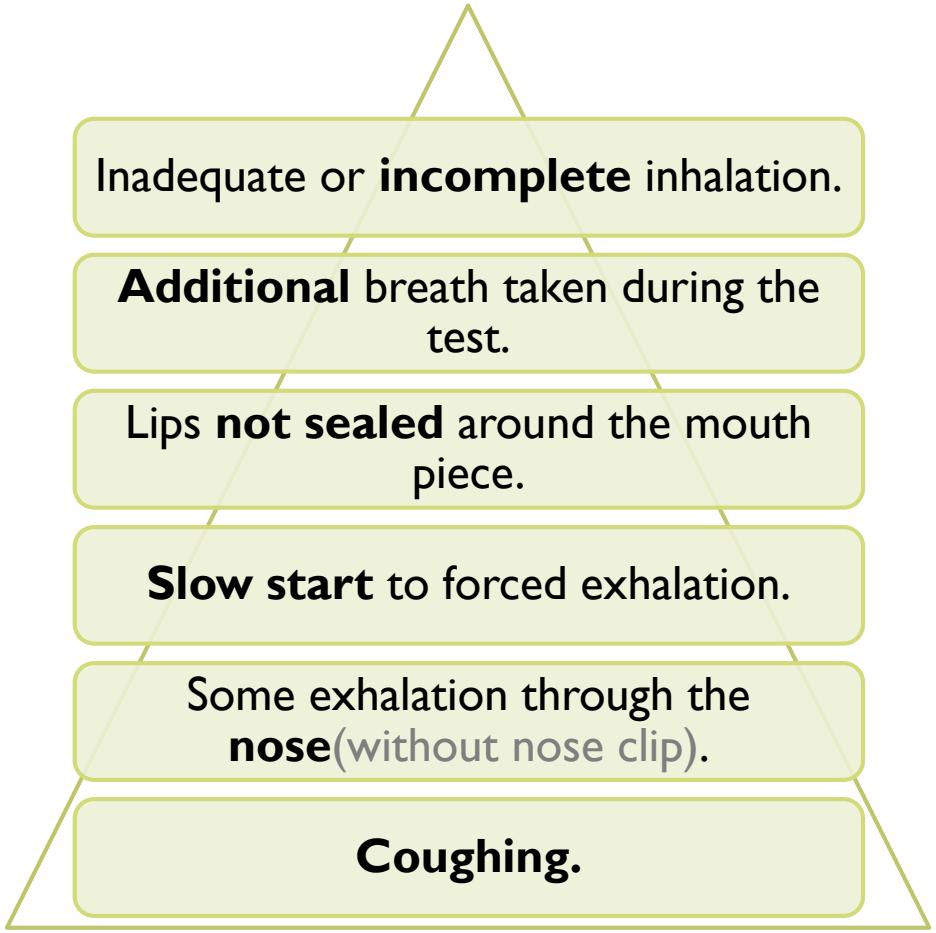


Result classification:

1. Normal
2. Obstructive
3. Restrictive
4. Combined (obstructive and restrictive)

Maintaining Accuracy

- The most common reasons for inaccurate results:



- الأخصائيين يتعبون مرة مع بعض المرضى خصوصاً كبار السن والأطفال لأنهم ما يتبعون التعليمات بشكل صحيح فيضطرون يعيدون كم مرة لعلهم يحصلون على نتيجة دقيقة.

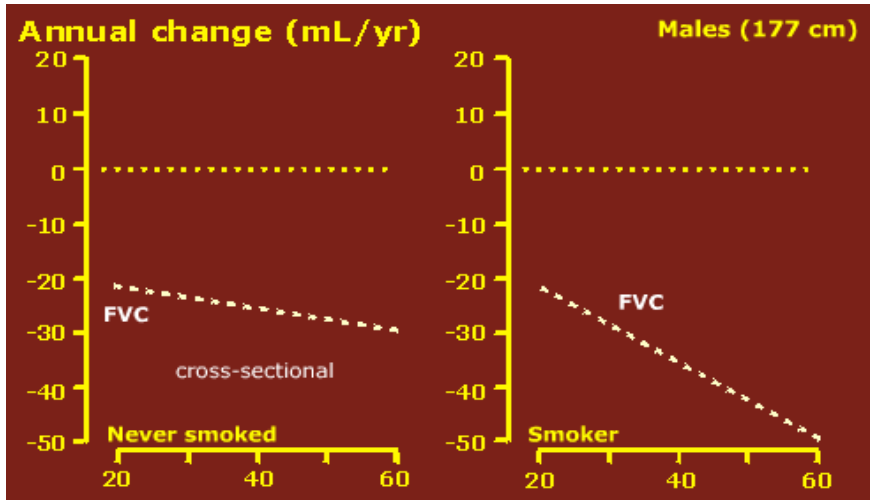
Smoking and Spirometry

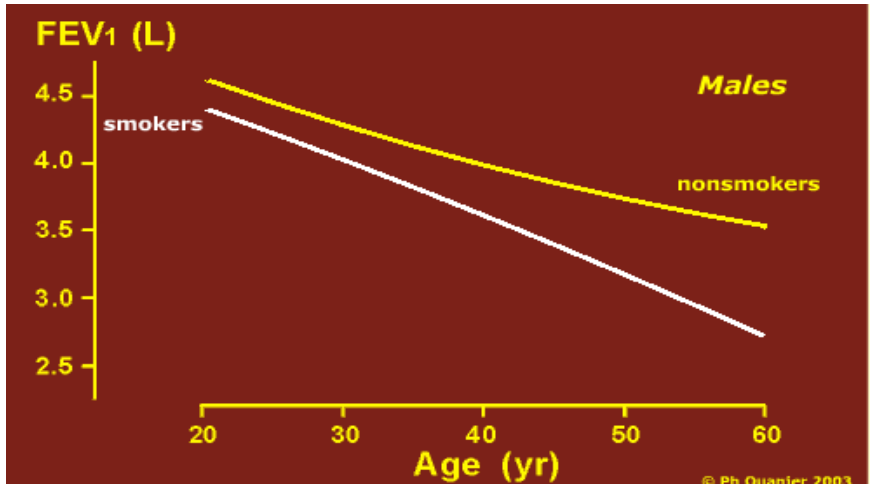
Effects of smoking on lung function:

- Non-Smoker: In normal healthy non-smoker subject after the age of 30-35 the expected decline in lung function parameter [FEV1] is 25–30 ml/ year

- Smokers: 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

In healthy person the curve goes down slowly in comparison with smoker.

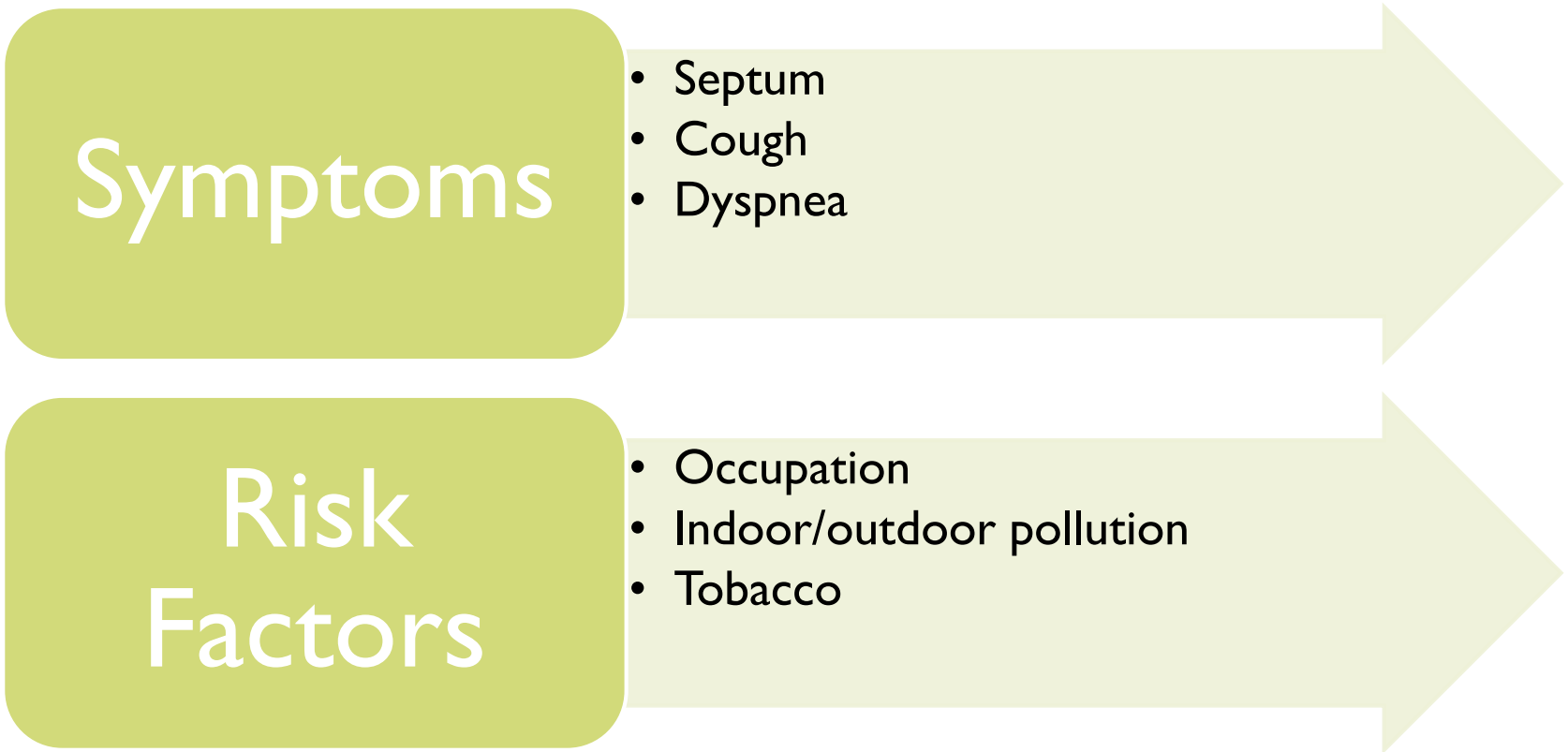




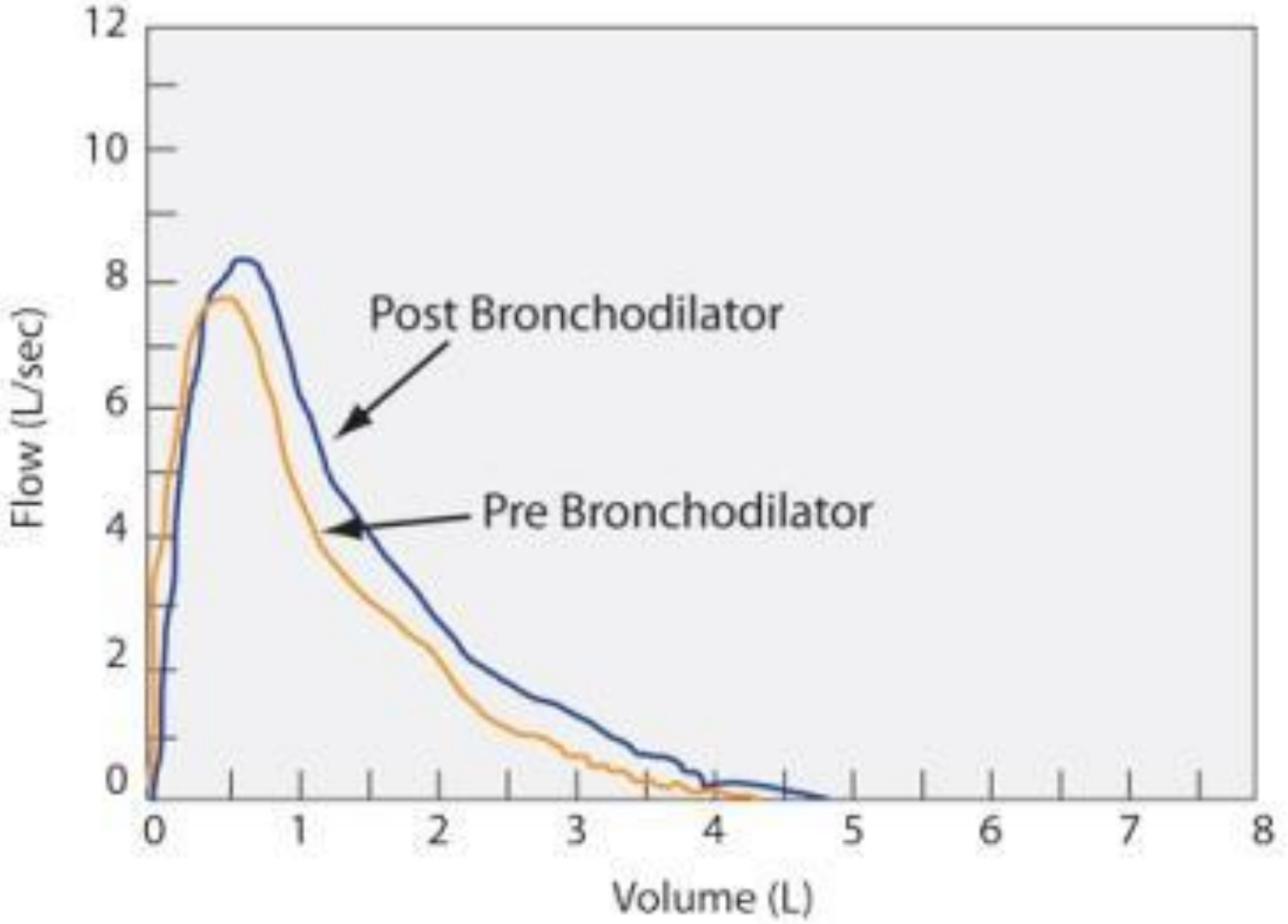
Diagnosis of COPD

All of these indicate the use of Spirometry to diagnose COPD:

(When you see them -> use a spirometer to diagnose COPD)



Spirometry in Respiratory Diseases

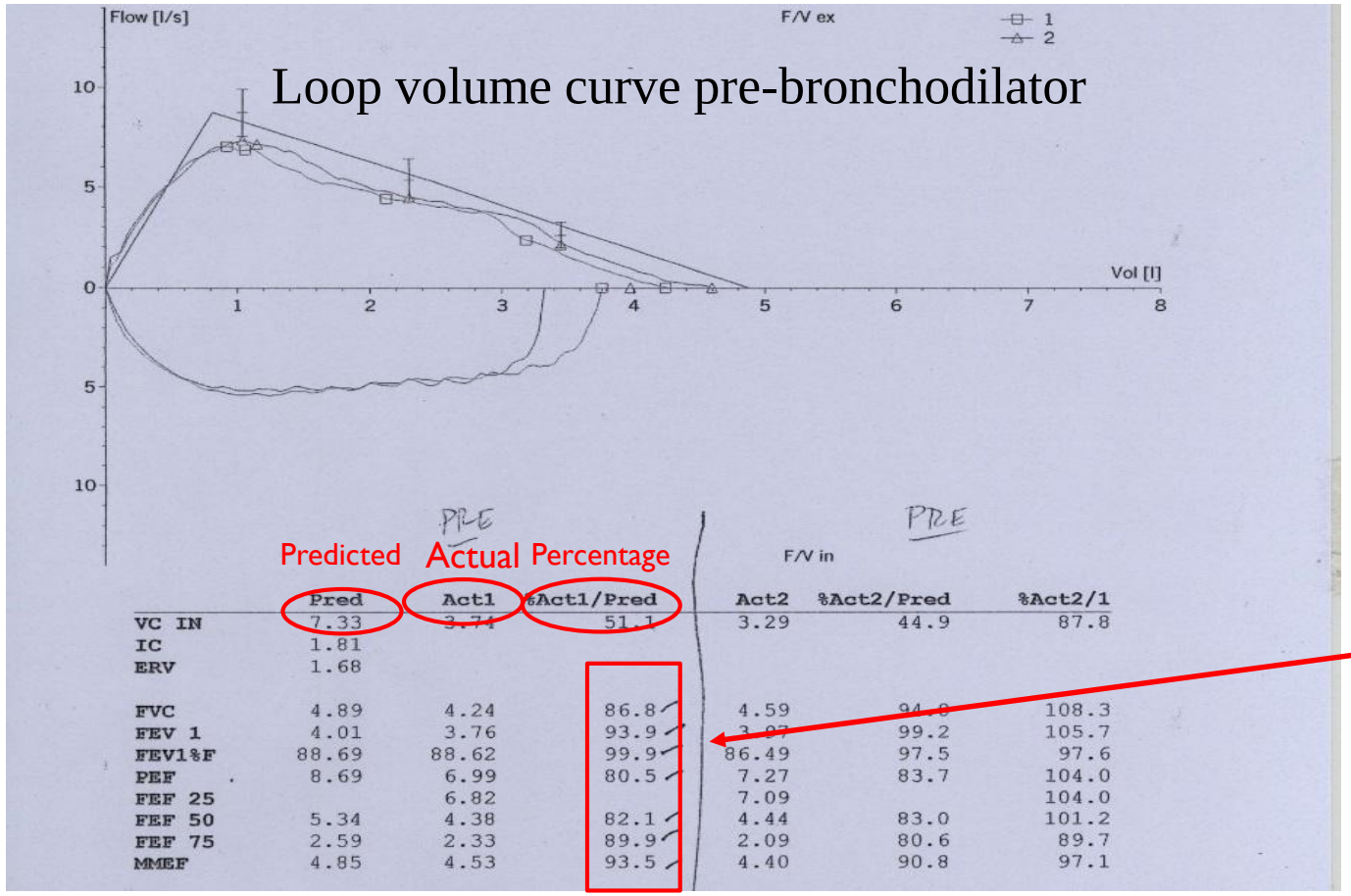


طريقة الاختبار:
الاختبار يتسوى مرتين المرة الأولى قبل ما نعطيه موسع الشعب الهوائيه .
نسميه Pre Bronchodilator
والمرة الثانية بعد ما نعطيه موسع الشعب الهوائية نسميه Post Bronchodilator ,

في الصورة تحسنت القراءات بين Pre and Post هذا يعنى انه الانسان هذا كان عنده ضيق في الشعب الهوائيه ويوم عطيناه الموسع توسعت شعبه الهوائيه . أما اذا ما صار في تحسن يعني انه الانسان سليم (شعبه الهوائيه طبيعية) فالموسع مب مأثر عليه

Spirometry in Respiratory Diseases

مب جاي عليه أسئلة



	Pred	Act1	%Act1/Pred	Act2	%Act2/Pred	%Act2/1
VC IN	7.33	3.74	51.1	3.29	44.9	87.8
IC	1.81					
ERV	1.68					
FVC	4.89	4.24	86.8	4.59	94.0	108.3
FEV 1	4.01	3.76	93.9	3.97	99.2	105.7
FEV1%F	88.69	88.62	99.9	86.49	97.5	97.6
PEF	8.69	6.99	80.5	7.27	83.7	104.0
FEF 25		6.82		7.09		104.0
FEF 50	5.34	4.38	82.1	4.44	83.0	101.2
FEF 75	2.59	2.33	89.9	2.09	80.6	89.7
MMEF	4.85	4.53	93.5	4.40	90.8	97.1

All values are above 80 = normal

Patient is normal so no need for bronchodilator challenge

Firstly, we enter age, height, weight and ethnicity to electronic spirometer → a graph will appear (spirogram)

Three values will appear on spirogram
Predicted, Actual, and Percentage

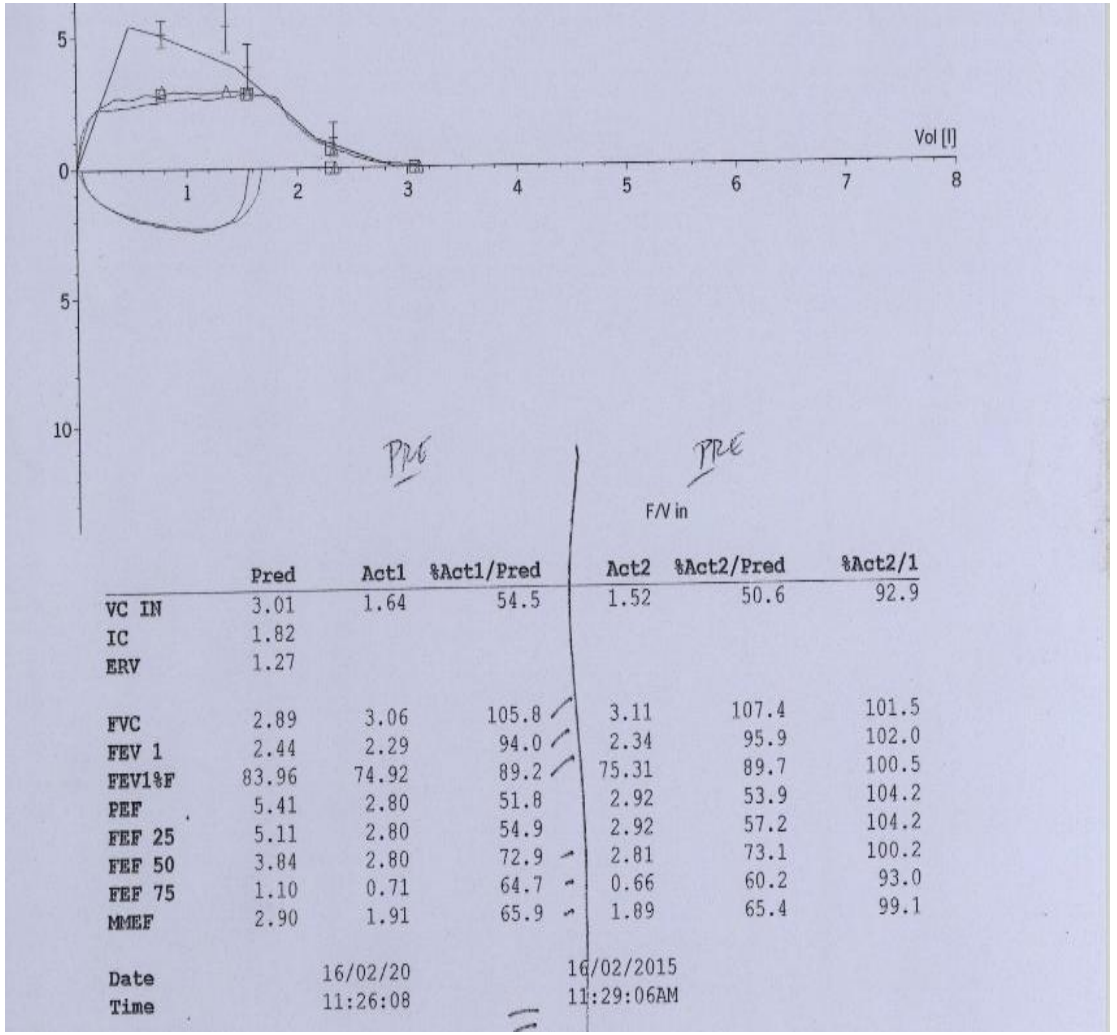
We look at the percentage for diagnosis:

Percentage 80 = normal
Percentage 70-80 = mild problem
Percentage 60-70 = moderate problem
Less than 60 = severe problem

Other Examples of Spirograms

	Pred	Act1	%Act1/Pred	Act2	%Act2/Pred	%Act2/1
VC IN	2.53	1.38	54.7	1.40	55.3	101.1
IC	1.88					
ERV	1.20					
FVC	3.01	2.21	73.5	2.35	78.3	106.5
FEV 1	2.77	1.94	70.3	1.92	69.5	98.9
FEV1%F	92.90	88.00	94.7	81.73	88.0	92.9
PEF	5.69	3.15	55.3	3.38	59.4	107.5
FEF 25	5.57	3.15	56.5	2.90	52.1	92.3
FEF 50	4.55	2.04	44.9	1.89	41.5	92.5
FEF 75	1.86	1.20	64.9	0.98	53.0	81.6
MMEF	3.71	1.91	51.4	1.74	46.8	91.0

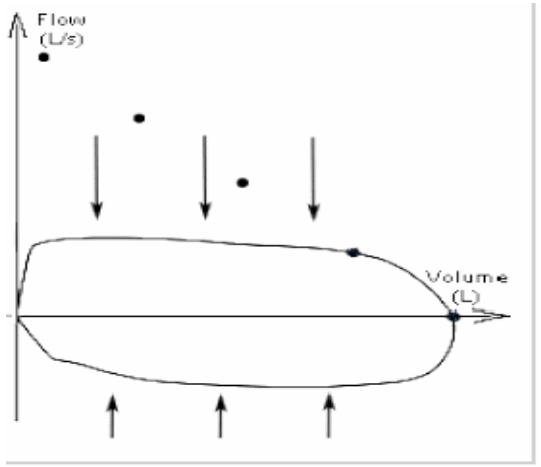
	Pred	Act1	%Act1/Pred	Act2	%Act2/Pred	%Act2/1
VC IN	4.19	3.14	74.9	3.25	77.6	103.6
IC	2.28					
ERV	1.52					
FVC	3.99	4.61	115.5	4.92	123.3	106.7
FEV 1	3.50	3.37	96.4	3.59	102.5	106.4
FEV1%F	85.83	73.20	85.3	72.94	85.0	99.6
PEF	8.09	8.57	105.9	7.59	93.9	88.6
FEF 25		6.87		7.59		110.5
FEF 50	4.62	2.73	59.0	2.83	61.2	103.6
FEF 75	2.02	0.90	44.5	0.91	44.9	100.9
MMEF	4.02	2.29	57.1	2.40	59.8	104.7



	Pred	Act1	%Act1/Pred	Act2	%Act2/Pred	%Act2/1
VC IN	3.01	1.64	54.5	1.52	50.6	92.9
IC	1.82					
ERV	1.27					
FVC	2.89	3.06	105.8	3.11	107.4	101.5
FEV 1	2.44	2.29	94.0	2.34	95.9	102.0
FEV1%F	83.96	74.92	89.2	75.31	89.7	100.5
PEF	5.41	2.80	51.8	2.92	53.9	104.2
FEF 25	5.11	2.80	54.9	2.92	57.2	104.2
FEF 50	3.84	2.80	72.9	2.81	73.1	100.2
FEF 75	1.10	0.71	64.7	0.66	60.2	93.0
MMEF	2.90	1.91	65.9	1.89	65.4	99.1
Date		16/02/20		16/02/2015		
Time		11:26:08		11:29:06AM		

مب جاي عليه أسئلة

Cont.



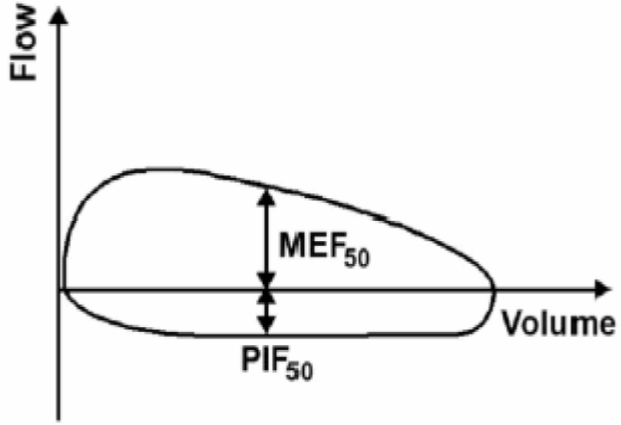


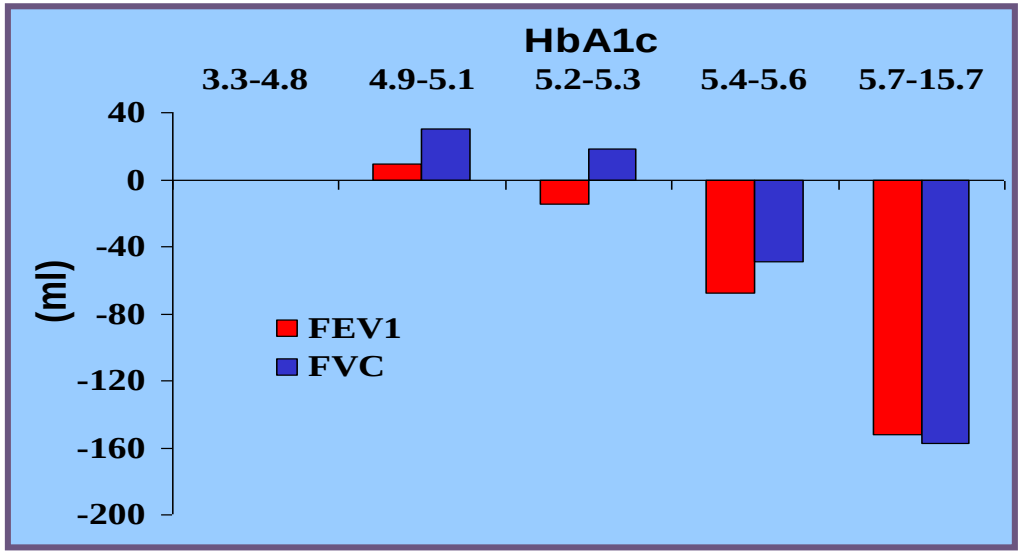
Figure-8: Fixed airway obstruction.

Any trauma (road car accident / surgery…) can cause obstruction of the airway

Intrathoracic airway obstruction: obstruction in lower parts of respiratory tract.

Extrathoracic obstruction: obstruction in upper parts of respiratory tract

SPIROMETRY& HbA1c



Increase in mean HbA1c is associated with decrease in lung function parameters FVC & FEV1

"بعض" من دراسات الدكتور

Spirometry and Diabetes Mellitus

Type 1 and type 2 diabetic patients showed a significant reduction in the:

- Forced Vital Capacity [FVC]
- Forced Expiratory Volume in one Second [FEV1]
- Peak Expiratory Flow [PEF]
- Forced Expiratory Flow [FEF25-75%]

Additionally, Stratification of results by years of disease showed a dose-response effect on lung function.

Spirometry and Cement Industry

Lung Function Parameters

- FVC
- FEV1
- FEF 25-75 % and
- PEF were significantly decreased in cement mill workers compared to their matched controls

Spirometry and Welding Industry

Lung Function Parameters:

- FVC
- FEV1
- PEF were significantly impaired in welding workers compared to their matched controls

E.g. heavy manual labor or fire fighting.

Spirometry and Oil Spill

Lung Function Parameters FVC, FEV_1, and FEF 25-75% were impaired in subjects exposed to crude oil spill in sea water

TAKE HOME MESSAGES

- The incidence of respiratory diseases has been increased, hence the importance of lung function test cannot be ignored.
- Respiratory assessment through Spirometry may be mandatory at all the levels of respiratory care / clinical settings.
- As we cannot treat the patient with high blood pressure without knowing the blood pressure; Similarly, we cannot treat the patients with respiratory problems without knowing the lung function test [Spirometry].

Quiz + Videos

- https://www.onlineexambuilder.com/lung-function-in-health-and-disease/exam-128572

Video of (Spirometry)
Duration: (6)mins

Video of (Obstructive Vs Restrictive Lung Diseases)
Duration: (2)mins

Video of (COPD)
Duration: (4)mins

Link to Editing File

(Please be sure to check this file frequently for any edits or updates on all of our lectures.)

References:

- Girls' and boys' slides.
- Guyton and Hall Textbook of Medical Physiology (Thirteenth Edition.)

Thank you!

اعمل لترسم بسمة، اعمل لتمسح دمعة، اعمل و أنت تعلم أن الله لا يضيع أجر من أحسن عملا.

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