



MED437
KING SAUD UNIVERSITY



Lung Function In Health And Disease

- Color index:
- Red: important
 - Green: doctor's notes
 - Grey: extra information
 - Pink: found only in female's slides
 - Blue: found only in male's slides
 - Yellow: numbers

Physiology 437 teamwork

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physiologyteam437@gmail.com



[@physio437](https://twitter.com/physio437)



[Editing file](#)

objectives:

By the end of the lecture you will be able to:

- 1- Define the various lung volumes and capacities and provide typical values for each.
- 2- Define ventilation rates, their typical values, and their measurement.
- 3- Describe FEV1 and its role in differentiating obstructive and restrictive lung diseases.
- 4- Describe the types of dead space. State a volume for the anatomical dead space.
- 5- Define the term minute ventilation and state a typical value.
- 6- Distinguish minute ventilation from alveolar ventilation.

Types of lung function tests include

Only in females' slides

Spirometry

It is the measurement of the speed and the amount of air that can be exhaled and inhaled.

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. Calculate FRC and airway resistance

Cardiopulmonary Stress Testing

Used for evaluation of dyspnea that is out of proportion to findings on static pulmonary function tests . provides assessment of the integrative exercise responses involving the pulmonary, cardiovascular and skeletal muscle systems

Diffusing Capacity of Lung for Carbon Monoxide

To evaluate the presence of possible parenchymal lung disease. للتأكد من عدم وجود خلل في وظيفة الرئة الأساسية تبادل الغازات

Pulse Oximetry

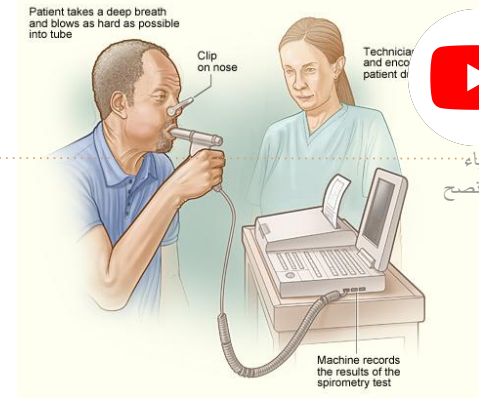
The principle is measurement of O₂ saturation by spectrophotometry.

الفكرة من هذي السلايد أن تفهم أن الـ PFT متنوعة ولها استعمالات أخرى وليست فقط spirometry

Spirometry

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

It is **widely used, effort depended basic lung function test**



يشرح أشياء كثيرة ، ننصح به 6:00

Spirometry is a simple most commonly used test to:

- Assess the lung performance
- Measure the physiological parameters: Lung volumes Capacities Flow rate
- Differentiate between the obstructive and restrictive lung conditions“diseases”
- Play a critical role in the diagnosis, differentiation and management of respiratory diseases*

*الإختبار ماراح يعطينا معلومات عن ال Diagnosis فقط ، راح نعرف أيضاً ال Prognosis بإعادة الإختبار للمريض كل فترة

Physiological conditions affecting lung functions

Age : عند الأطفال تكون منخفضة بسبب عدم اكتمال نمو الرئتين عندهم بشكل كامل، وعند اكتماله تبدأ بالزيادة حتى عمر الـ 35 ثم يبدأ بالإتخفاض تدريجياً

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 مثلاً غالباً الأفريقيين والأوروبيين يكونون طوال وبنيتهم الجسدية كبيرة "فتكون عالية" والاسيويين بنيتهم صغيرة "فتكون منخفضة"

Exercise: Enlarged uterus will also put pressure on the diaphragm.

Posture: عندما يكون الإنسان في وضع erect راح يكون الـ lung functions عالي

Pregnancy: Enlarged uterus will also put pressure on the diaphragm.

Diurnal variation, seasonal, climate

Customary activity

Geographical location

Some information is from team436

Indication Of Spirometry

1-Symptoms:

- Dyspnea ضيق تنفس
- Cough
- Phlegm or sputum production
- Chest pain*

We mustn't use the spirometry for*
acute chest pain

لأن المريض يمكن يكون عنده

Coronary artery disease (CAD)

ومع الـ deep respiration راح يضخم المشكلة.

نقدر نستخدم الـ spirometry

للـ Chronic chest pain بعد نسوي للمريض
اختبارات ونتأكد إن القلب سليم ولا يزال الألم بالصدر

Sign: العلامات الظاهرة ويحددها الطبيب
Symptom: الذي يشعر به المريض

2-Abnormal chest X-Ray



4-Arterial blood gas analysis:

- Hypoxemia
low level of O₂ in blood.
- Hypercapnia
High level of Co₂ in blood.

3-Signs:

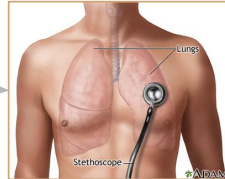
- Cyanosis ازرقاق اللثة وأطراف الأصابع
- Clubbing Drumstick fingers
- Chest deformity E.g. : Kyphosis
- Diminished chest expansion
نقول للمريض يقعد بشكل erect ونخليه ياخذ deep inspiration ، وراح يكون توسع الصدر محدود.
- Hyperinflation

زيادة في

Functional Residual Capacity(FRC)

فنشاهد تضخم بالرئتين في X-ray

- Diminished breath sounds
باستخدام السماعة الطبية نسمع صوت خفيف للتنفس
بسبب تجمع "سوائل" effusion
- Prolongation of expiratory phase & crackles



Indication Of Spirometry cont.

Occupations settings:

- Pre employment spirometry يجب أن يُستخدم للموظفين قبل التوظيف
- Periodic lung function examination for workers exposed to toxic substances including dust and fumes in industrial sectors such as:*
- Cement / Asbestos معادن يتم استخراجها من مناجم خاصة
- Welding حدادة / Wood / Steel
- Flour / Coal mine / Oil

-العمال اللي يشتغلون في المصانع ويتعرضون لمواد سامة يجب أن نسويهم الإختبار "Spirometry" بشكل دوري للتأكد بعدم تعرضهم لمشاكل رئوية.

Indications of Spirometry

•Describe the course of diseases affecting PFTs:

1. Neuromuscular diseases:
Gillian Barre Syndrome, Myasthenia gravis.
2. Pulmonary diseases:
Obstructive airway diseases, Interstitial lung diseases.
3. Adverse reactions:
Drugs with known pulmonary toxicity [Pulmonary fibrosis]

•monitoring indications :

To assess the therapeutic interventions:

- Bronchodilator therapy
- Steroid treatment for asthma
- Chronic obstructive lung disease
- Interstitial lung disease

(measure the response to the treatment of conditions which spirometry is used) نعيده بشكل متكرر
عشان نشوف النتائج والاستجابة للعلاج

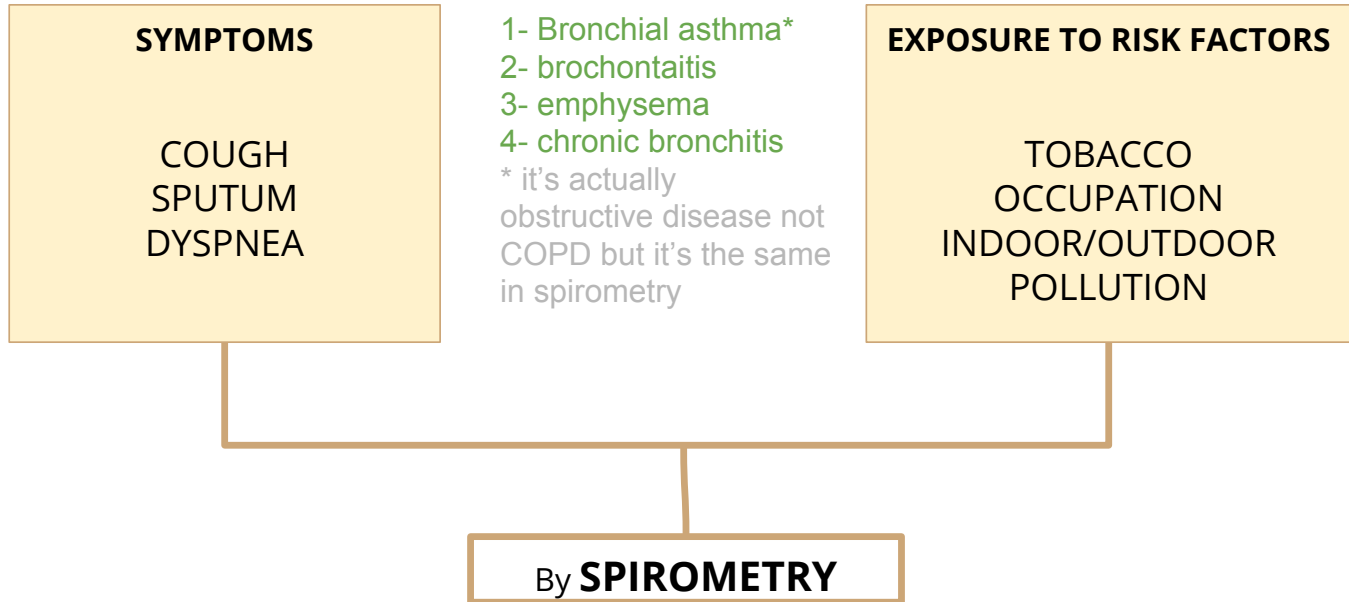
PRE OPERATIVE INDICATIONS

-To determine the suitability of patients for anesthesia*

-To assess the risk for surgical procedures known to affect lung function. أثر نفس العملية وليس التخدير

مثل ما نعرف أن التنفس يحتاج عمل للعضلات والتخدير ممكن يضعف هالعضلات فلما يكون الشخص عنده خلل في التنفس من الأصل فالتخدير ممكن يسبب مشاكل فلا بد نختبر التنفس قبل التخدير

Diagnosis Of COPD



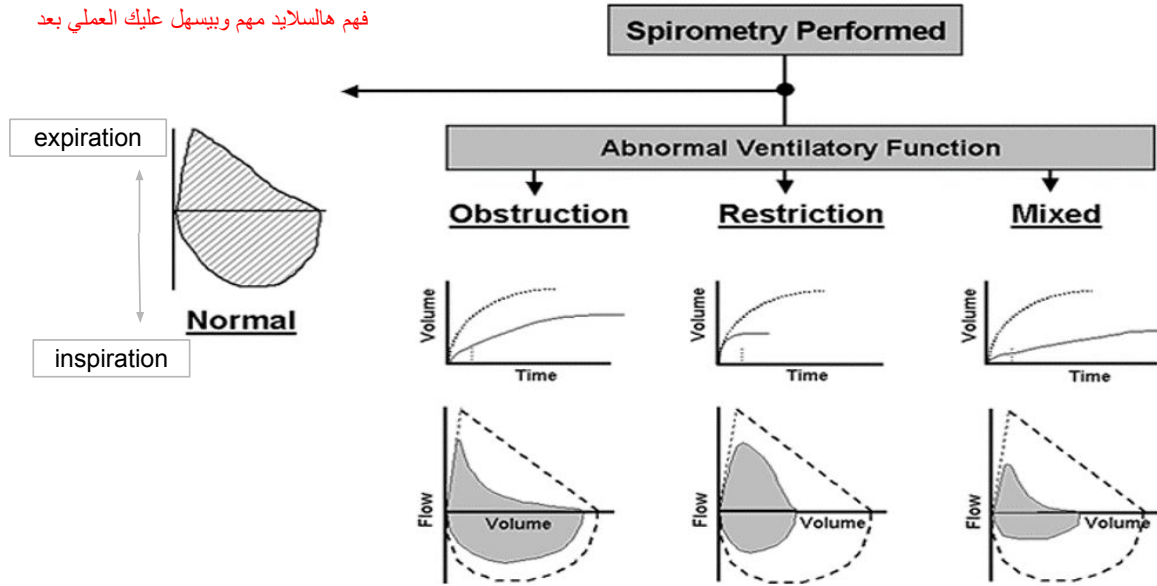
Spirometry In Respiratory Diseases



-Results classification

فهم هالاسلايد مهم وبيسهل عليك العملي بعد

- Normal
- Obstructive
- Restrictive
- Combined



1: prolong
2: smaller than the normal
+ concave curved

1: short & flattened
2: smaller than the
normal

1: prolong and flattened
2: combination between
obstruction & restriction

ناخذها حبة حبة وبنفهمها فهم عميق ..

Extra slide

Spirometry Performed

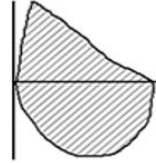
الكلام هنا عن

Forced Vital Capacity (FVC) and FEV1 إذا ما تعرفها لا تضيع وقتك وارجع للمحاضرة الي قبل هذي

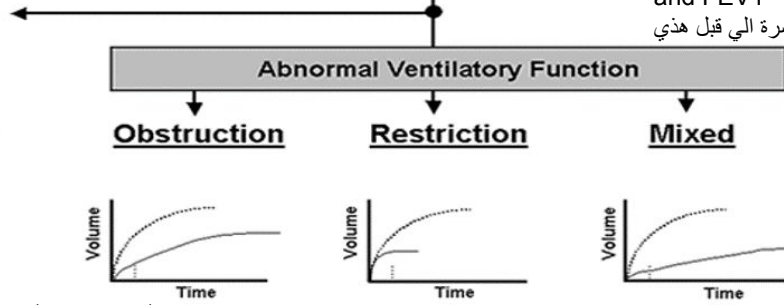
أول شيء:

$$\text{Flow} = V/T$$

بالعربي أن التدفق هو حجم الهواء الذي يخرج من الرئة في زمن محدد لما نثبت الحجم ويكون الوقت أطول وش يصيبير ؟ الفلو يكون أقل



Normal



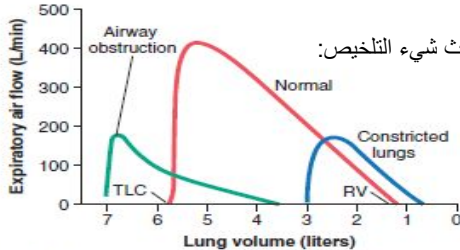
ثاني شيء أقرأ هنا

قلنا بالاسلايد الي قبلها أن الوقت يكون أطول. ليه أطول ؟ لأن الاوبستريكتف تكون مسارات الهواء أضيق فالهواء صعب يطلع (الفلو قليل)

في الريستريكتيف حجم الرئة كله يقل لأن الكومبلنس للرئة كله ضعف ومعد تتمدد، خروج الهواء طبيعي (لكن كميته قليلة مرة وهنا المشكلة) وفي الرسمة فوق لو تلاحظ أن في البداية الخروج ماشي مع النورمال (FEV1) لكن توقف عشان الFVC كله على بعضه قليل وخلص. الرسمة تحت نفس النورمال لكن قليل.

في الميكسد تكون موجودة العلامة المميزة لكل واحد من الاثنين، في الاوبستريكتف المميز هو نزول الFEV1 أما في الريستريكتف المميز هو نزول جميع الفوليوم وبالتالي نزول FVC

الرسمة توضحها بالأرقام لتقريب الفهم



ثالث شيء التلخيص:

Obstructive:
Normal or increased FVC
Decreased FEV1
Decreased FEV1/FVC

Restrictive :
Decreased FVC
Decreased FEV1
Normal FEV1/FVC

Mixed:
Decreased FVC
Decreased FEV1
Decreased FEV1/FVC

Figure 43-2. Effect of two respiratory abnormalities—constricted lungs and airway obstruction—on the maximum expiratory flow-volume curve. TLC, total lung capacity; RV, residual volume.

Maintaining Accuracy

Only in females' slides

The most common reason for accuracy for inaccurate results :

Inadequate or **incomplete inhalation**

التعليمات تكون صارمة لأن كثير من المرضى يخطي في التنفيذ فتطلع نتائج غير مفيدة ، الاختبار غالبا يعاد أكثر من مرة

Additional breath taken during the test

Lips not sealed around the mouth piece

ما يكون يتنفس في السبايروميتر فقط

Slow start to forced exhalation

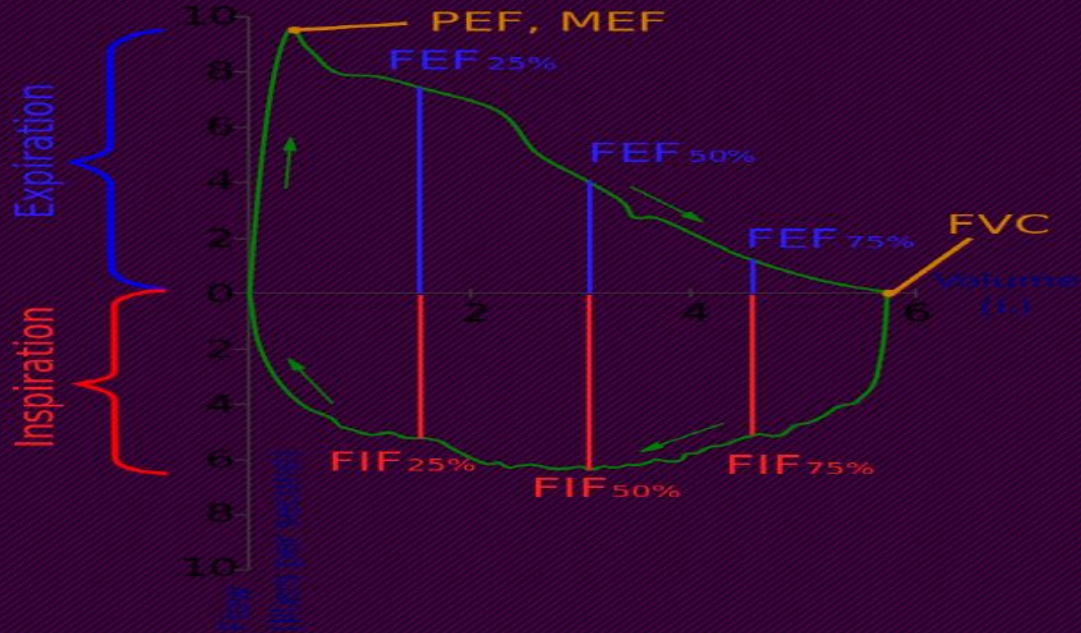
بياتر على FEV1

Some exhalation **through the nose**

coughing

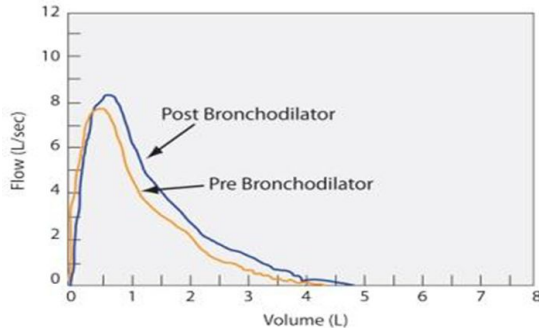
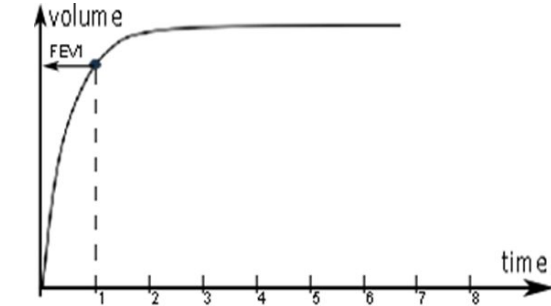
Spirometry In Respiratory Diseases

Only in males' slides

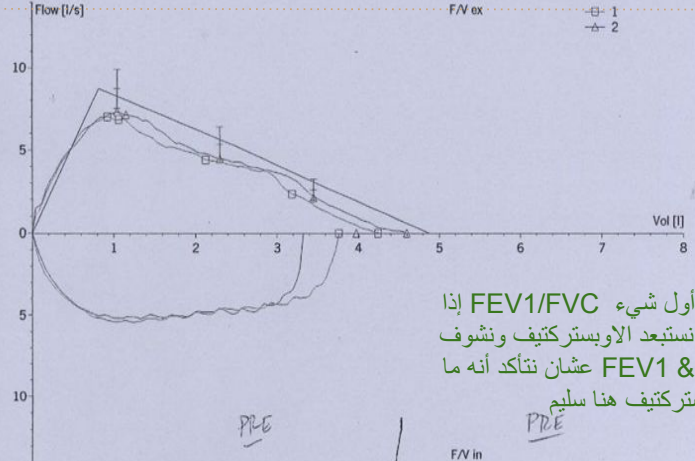


Spirometry in respiratory disease

Only in males' slides



هنا مثال على
استخدام
السبيروميتر
للبرقنوسيس ..
الأصفر قبل
البرونكودايلاتور
والأزرق بعد

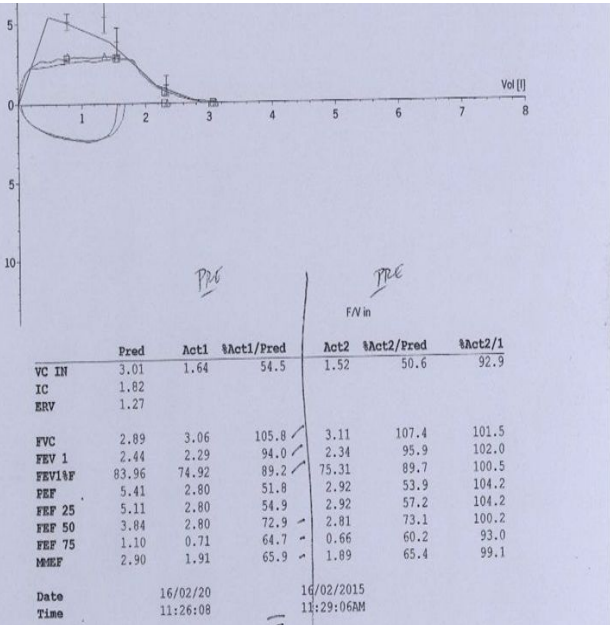


نشوف أول شيء FEV1/FVC إذا
طبيعي نستبعد الأوبستركتيف ونشوف
FEV1 & FVC عشان نتأكد أنه ما
فيه ريستركتيف هنا سليم

| | 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 |
| MMF | 4.85 | 4.53 | 93.5 ✓ | 4.40 | 90.8 | 97.1 |

Spirometry in respiratory disease

Only in males' slides



لما ندخل بيانات المريض
يعطينا الجهاز النتائج المتوقعة
ولما يختبر يعطينا النتيجة
الحقيقية و يقارنها بالمتوقعة
ويعطينا النسبة

80-100 % = NORMAL
70-80% = MILD
60-70 % = MODRATE
>60 % = SEVERE

| | Predicted | actual | | percentage | | |
|--------|-----------|--------|------------|------------|------------|---------|
| | 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 | 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 |

Spirometry in respiratory disease

Only in males' slides

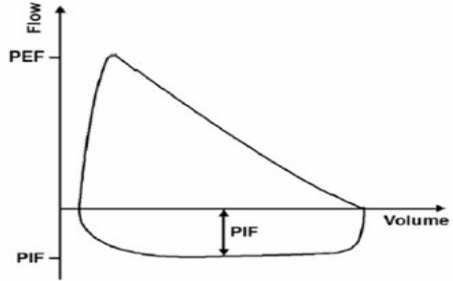
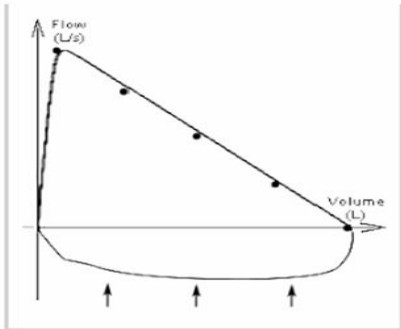


Figure-6: Extracellular obstruction (e.g., tracheal involvement above the sternal notch).

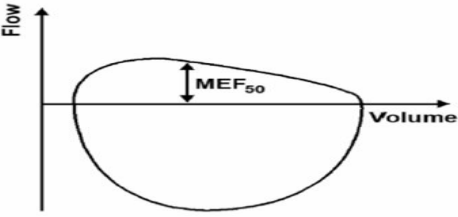
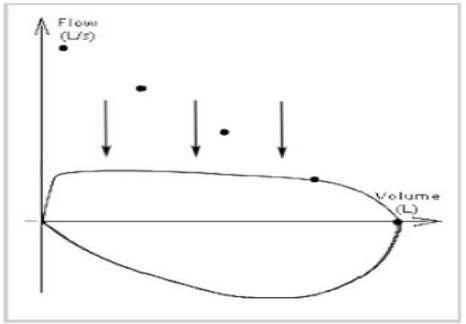
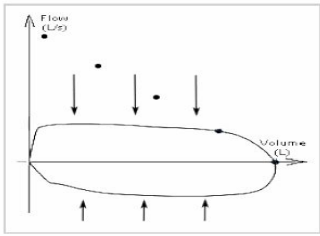


Figure-7: Intrathoracic obstruction.



Typical flattening of flow-volume loop in fixed airway obstruction

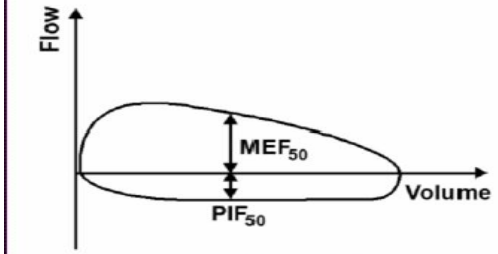
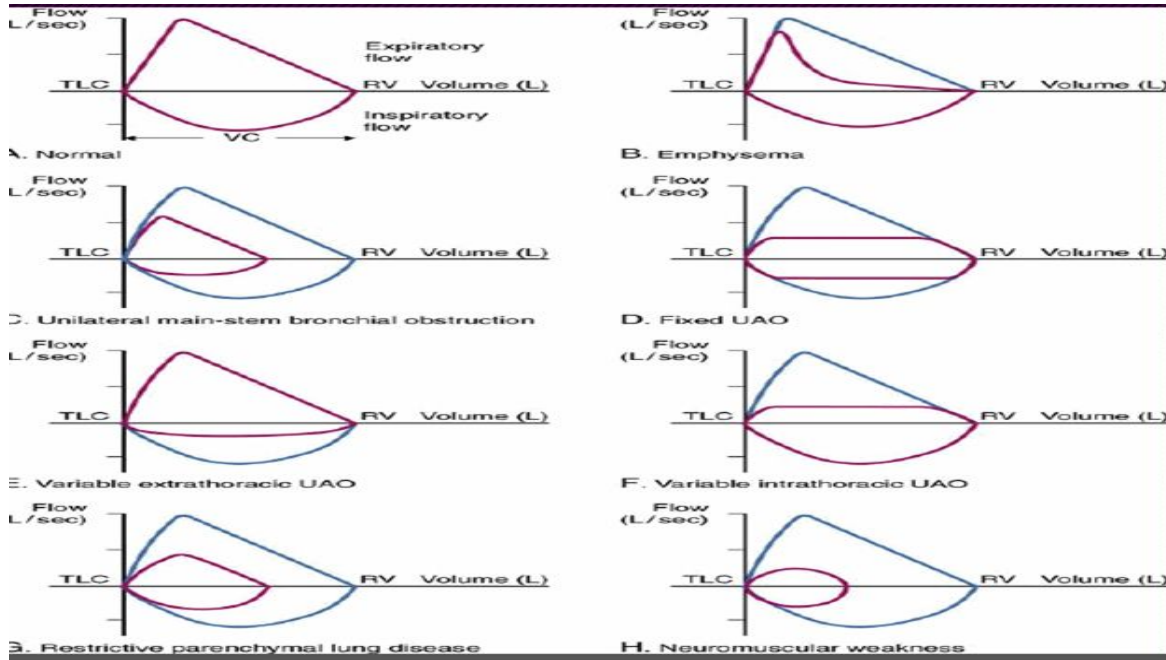


Figure-8: Fixed airway obstruction.

Spirometry in respiratory disease



Spirometry and smoking

Spirometry in smokers and non-smokers

Non smoker

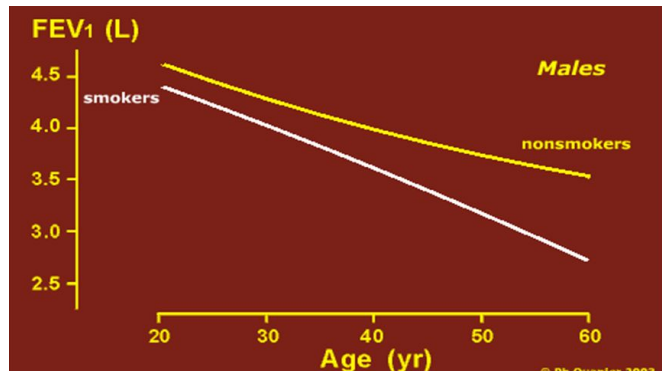
Average of decline
of lung function

- Measured by FEV1
- After the age of 30
- 25-30 ml/year

Smoker

Average of decline of lung
function

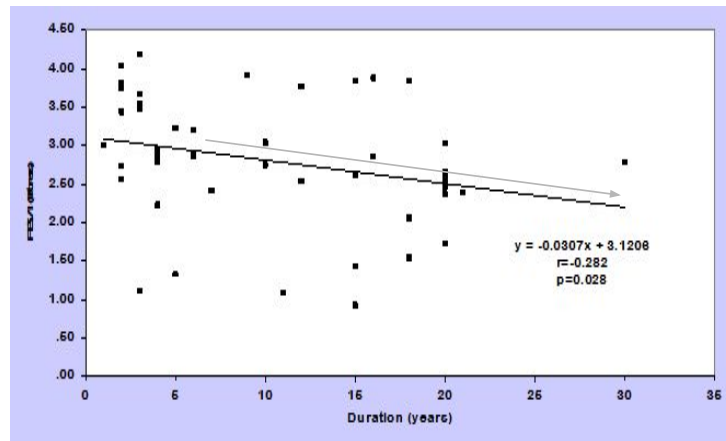
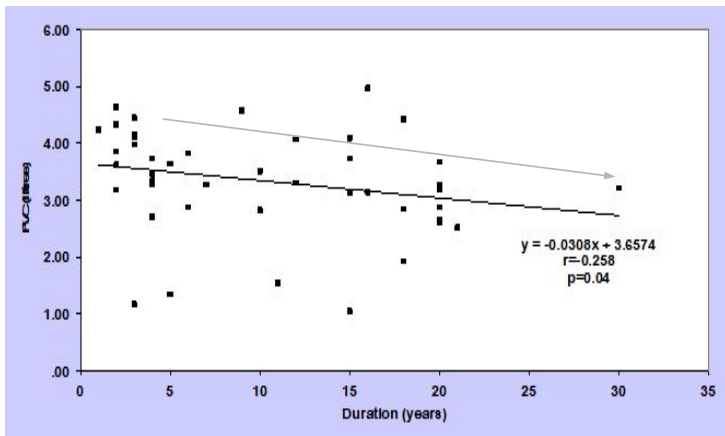
- Measured in by FEV1
- 60-70 ml/year



Smoker curves faster than the non smoker in the graph

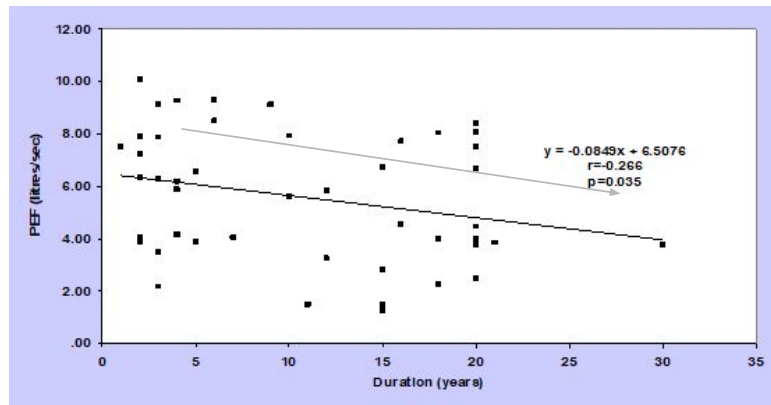
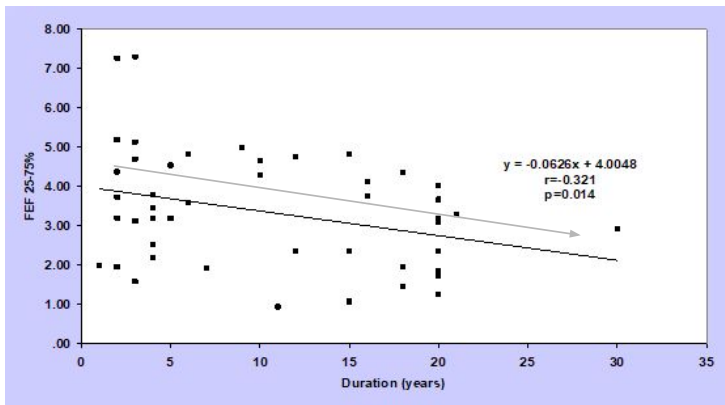
Impaired lung function in DM

Only in males' slides



Impaired lung function in DM

Only in males' slides



SPIROMETRY AND RESEARCHES

هذي دراسات للدكتور

SPIROMETRY IN

Cement
Industry

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

Welding
Industry

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

Oil Spill

Lung Function
Parameters FVC, FEV₁,
and FEF 25-75% were
impaired in subjects
exposed to crude oil
spill in sea water

Hba1c

يكون مرتفع عن
مرضى السكري

Increase in mean
HbA1c is associated
with decrease in lung
function parameters

FVC & FEV1

Summary

-Types of lung function tests include :
Spirometry - Gas diffusion - Body Plethysmography - Inhalation challenge test -Exercise stress test.

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

-Physiology conditions:
Age, Gender, Height, Weight, Ethnic group Exercise, Posture, Pregnancy.

-Diseases affecting pulmonary functions tests : Nerumuscular diseases , pulmonary diseases and adverse reactions.
-Lung functions has a wide differences between smokers and non-smokers.

Quiz

1- spirometry is used for:

- A- Acute chest pain
- B- Chronic chest pain
- C- Coronary Heart disease
- D- none of these

2- Lung functions are increased in people that are:

- A- Asthenic
- B- Pregnant women
- C- Tall

3- Myasthenia gravis is :

- A- Pulmonary diseases
- B- Neuromuscular diseases
- D- Cardiac diseases

4- which one of the following is considered as risk factor :

- A- Tobacco
- B- Cough
- C- Dyspnea

5- smoking affects the average decline of lung function measured with FEV1 by:

- A- it has no effect
- B- decreasing it
- C- increasing it

1-B , 2-C , 3-B , 4-A , 5-C

Female's team:

Leader: Alanoud Salman Alotaiby

Members:

1. Reem ALQarni
2. Sarah AlFlaij

Male's team:

Leader: Abdulhakim AlOnaiq

Members:

- 1- Mohammed Alhassan
- 2- Rayyan Almousa
- 3- Saad Alhaddab
- 4- Anas Alsowaida