Lung Function

وظيفة الرئة : تقيس قدرة الرئة على توصيل الهواء المحمل بالاوكسجين الى جدار الشعيرات ثم الكريات الحمر وكما غازات الدم.

Spirometry in Primary Care

Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2008

What is Spirometry?

Spirometry is a method of assessing lung function by measuring the volume of air the patient can expel from the lungs after a maximal expiration.


Spirometry
تخطيط وظيفة
الرئة يسجل
منحنى تعلم منه
الصابتك بالداء
الرئوي السداد

Standard Spirometric Indices

- FEV_1 - *Forced expiratory volume in one second:*

  The volume of air expired in the first second of the blow

- FVC - *Forced vital capacity:*

  The total volume of air that can be forcibly exhaled in one breath

- FEV_1/FVC *ratio:*

  The fraction of air exhaled in the first second relative to the total volume exhaled

Additional Spirometric Indicies

- MEFR – *Mid-expiratory flow rates:*
  Derived from the mid portion of the flow volume curve but is not useful for COPD diagnosis
- Peak Expiratory flow : PEF , the quantity of air you expel in one minute

These two indices are effort dependant

Spirogram Patterns

- Normal
- Obstructive
- Restrictive
- Mixed Obstructive and Restrictive

Spirometry

Predicted Normal Values

Predicted Normal Values

Affected by:

- ✓ Age
- ✓ Height
- ✓ Sex
- ✓ Ethnic Origin

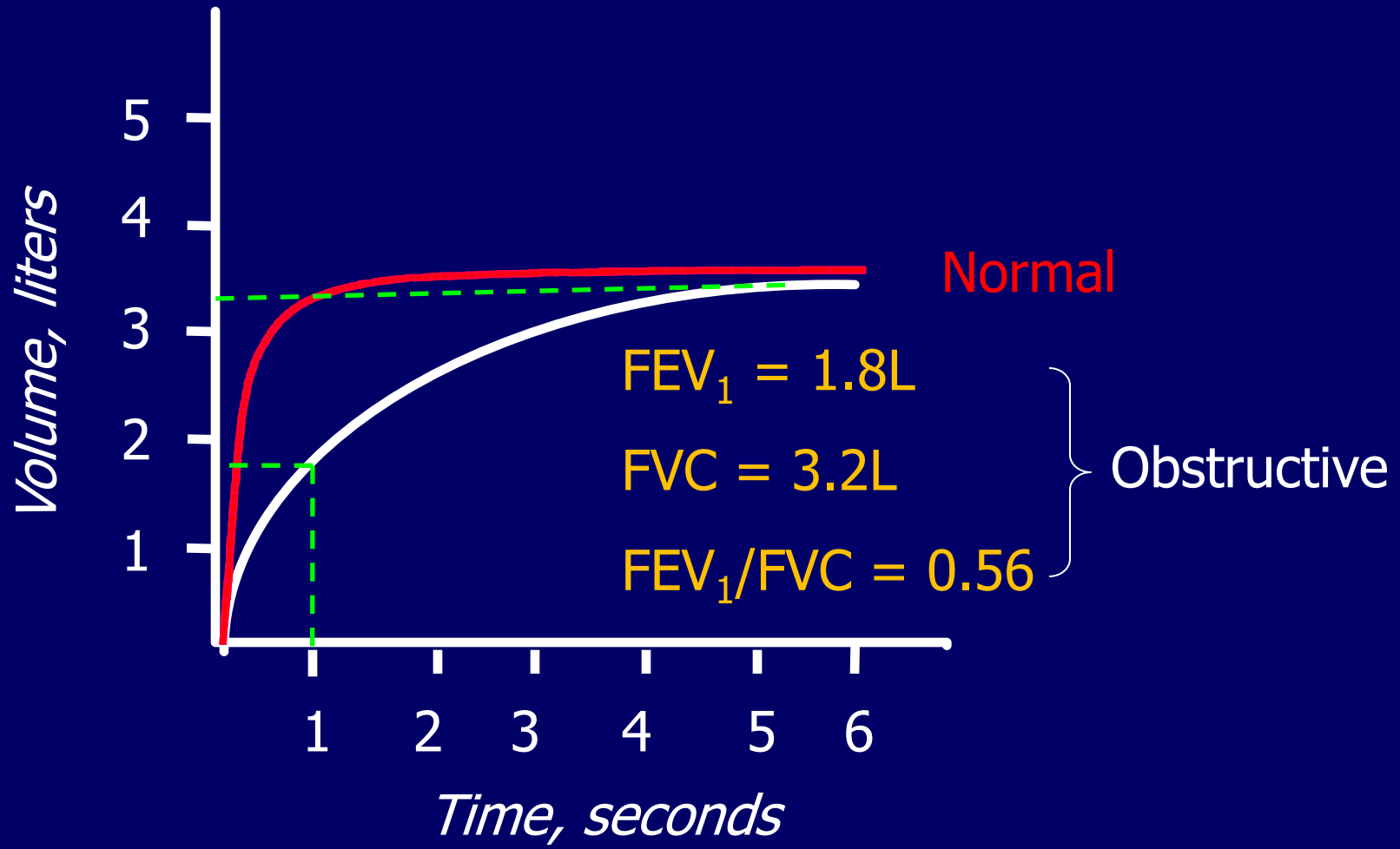
Criteria for Normal Post-bronchodilator Spirometry

- FEV_1: % predicted $\geq$ 80%
- FVC: % predicted $\geq$ 80%
- FEV_1/FVC: > 0.7

SPIROMETRY

OBSTRUCTIVE DISEASE

Spirometry : Obstructive Disease
After bronchodilatation



Spirometric Diagnosis of COPD

- COPD is confirmed by post–bronchodilator $FEV_1/FVC < 0.7$
- Post-bronchodilator FEV_1/FVC measured 10-15 minutes after 400µg salbutamol or equivalent

Figure 5.1-6. Bronchodilator Reversibility Testing in COPD

Results

- An increase in FEV_1 that is both greater than 200 ml and 12% above the pre-bronchodilator FEV_1 (baseline value) is considered significant

- It is usually helpful to report the absolute change (in ml) as well as the % change from baseline to set the improvement in a clinical context

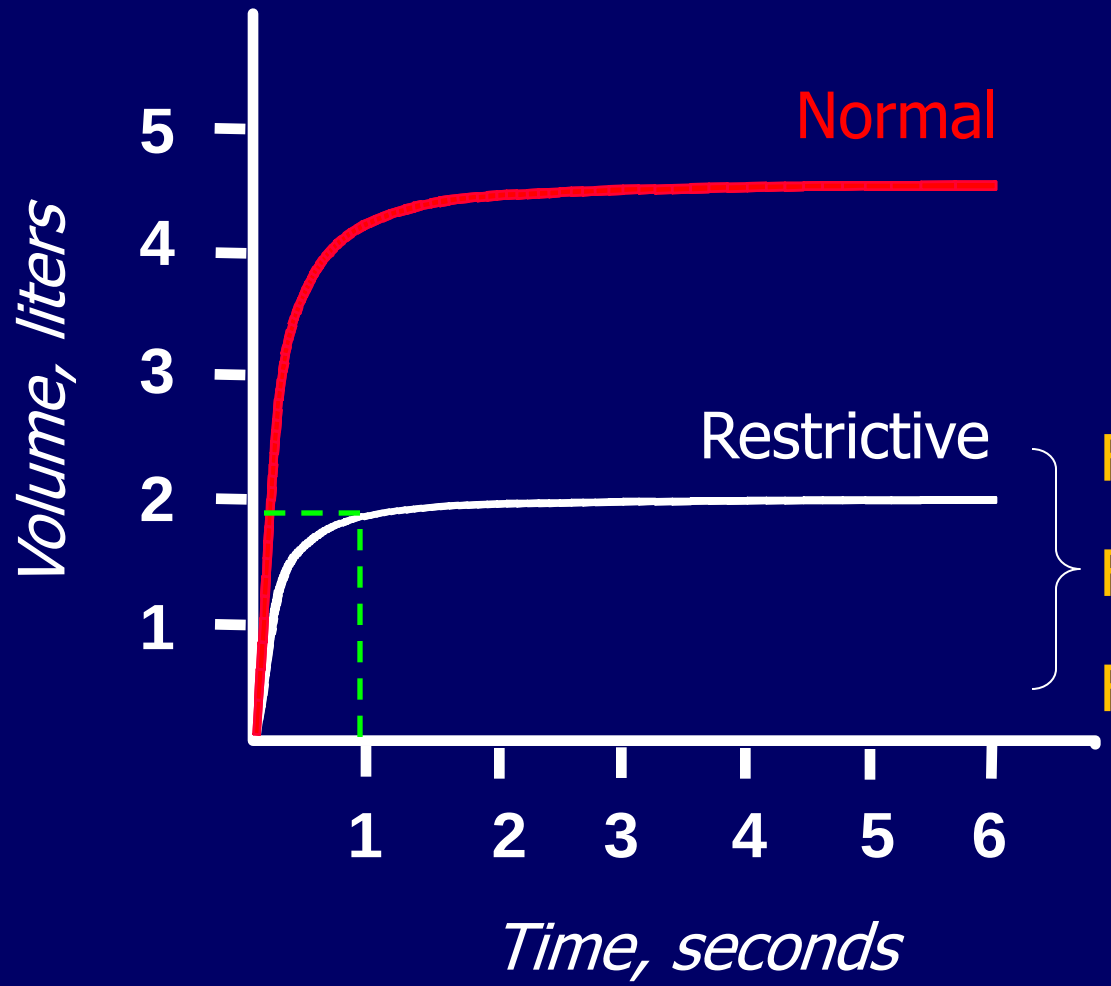
SPIROMETRY

RESTRICTIVE DISEASE

Criteria: Restrictive Disease

- $FEV_{1:}$ % predicted < 80%
- FVC: % predicted < 80%
- FEV_1/FVC: > 0.7

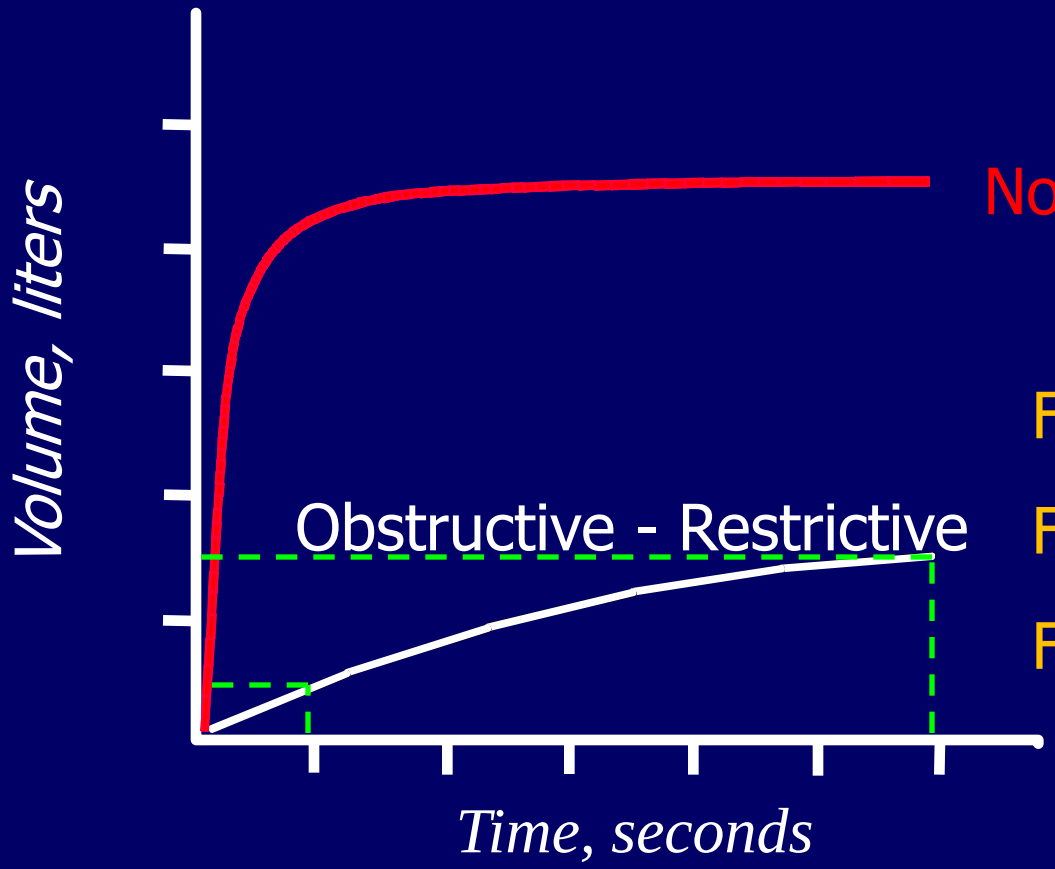
Spirometry: Restrictive Disease



Mixed Obstructive/Restrictive

- FEV_1: % predicted < 80%
- FVC: % predicted < 80%
- FEV_1 /FVC: < 0.7

Mixed Obstructive and Restrictive



FEV_1 = 0.5L

FVC = 1.5L

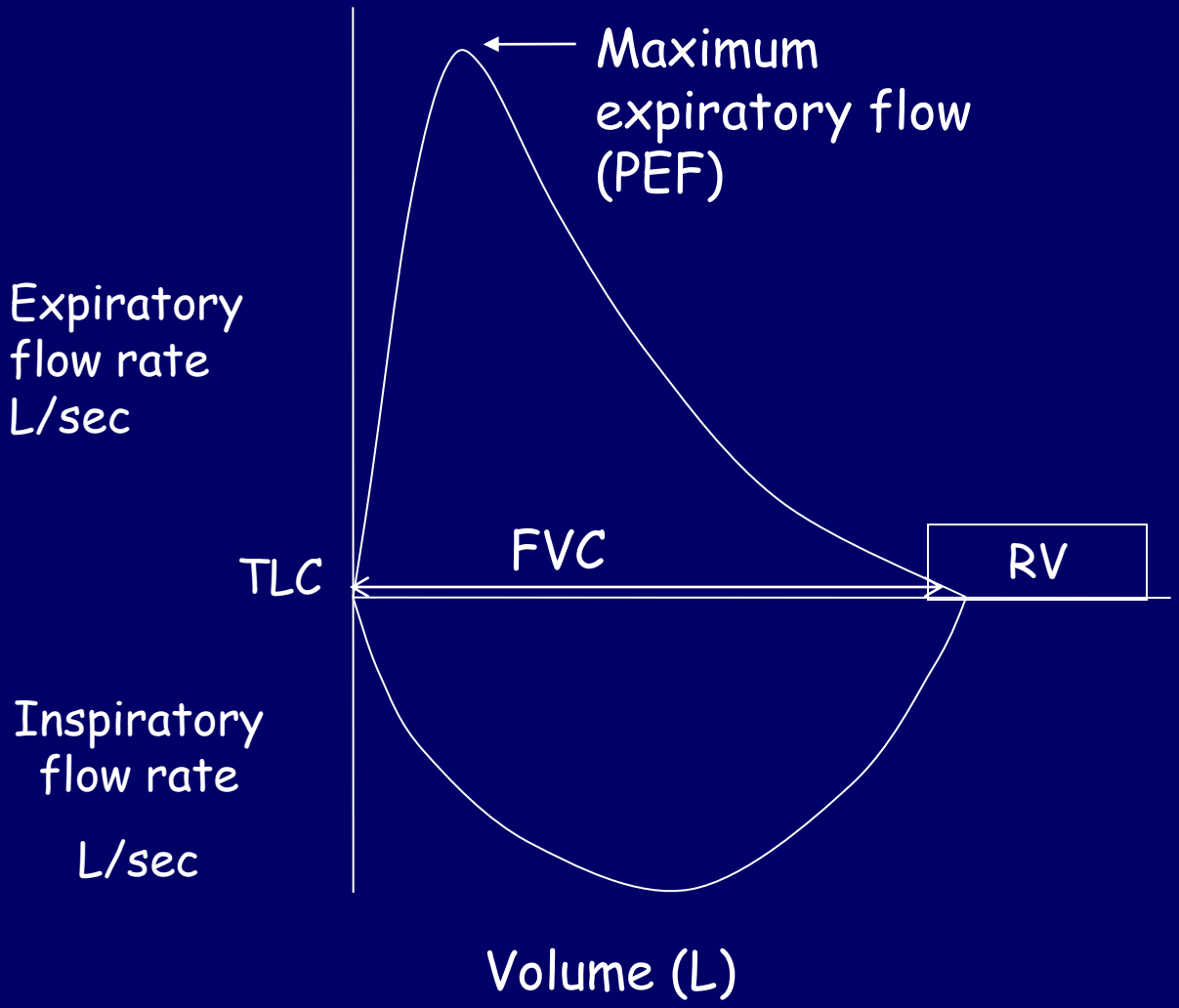
FEV_1/FVC = 0.30

Restrictive and mixed obstructive-restrictive are difficult to diagnose by spirometry alone; full respiratory function tests are usually required (e.g., body plethysmography, etc)

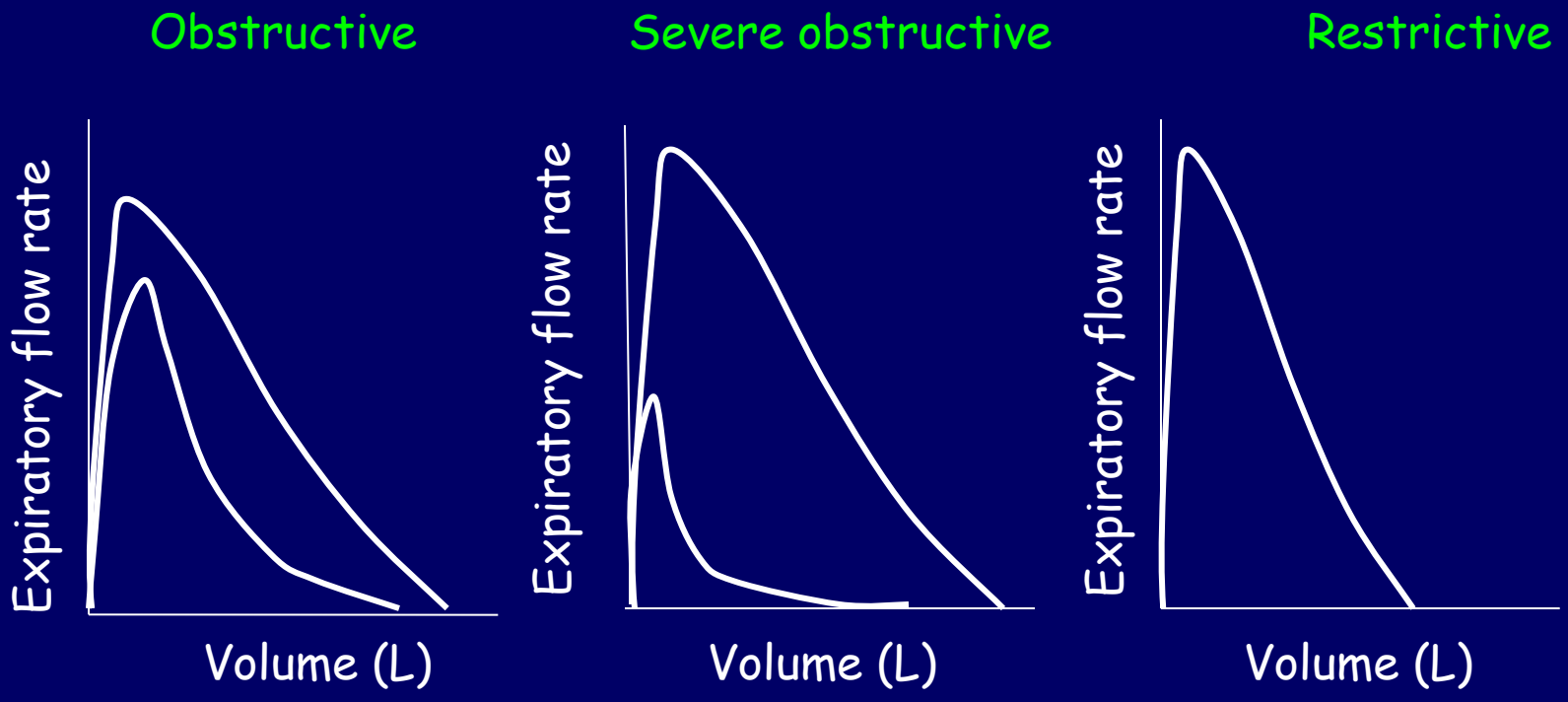
SPIROMETRY

Flow Volume

Flow Volume Curve



Flow Volume Curve Patterns Obstructive and Restrictive



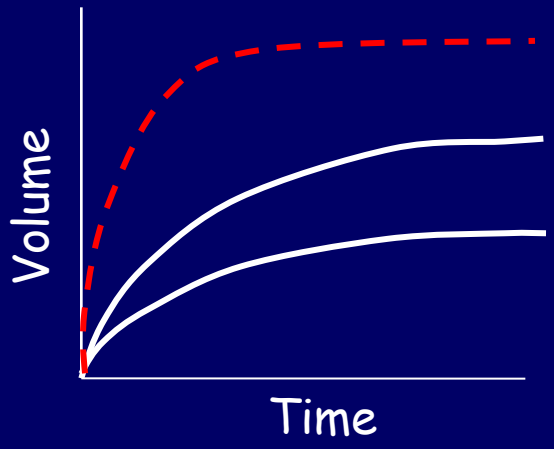
Reduced peak flow, scooped out mid-curve

Steeple pattern, reduced peak flow, rapid fall off

Normal shape, normal peak flow, reduced volume

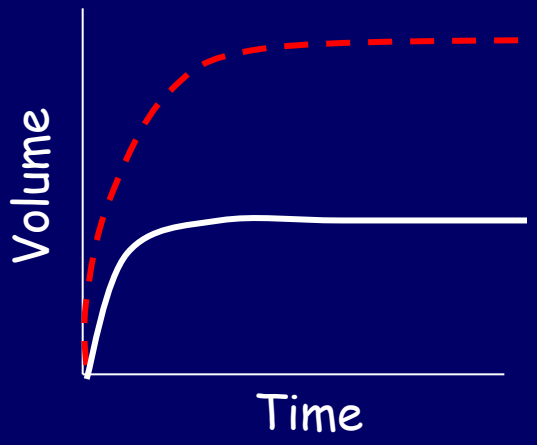
Spirometry: Abnormal Patterns

Obstructive



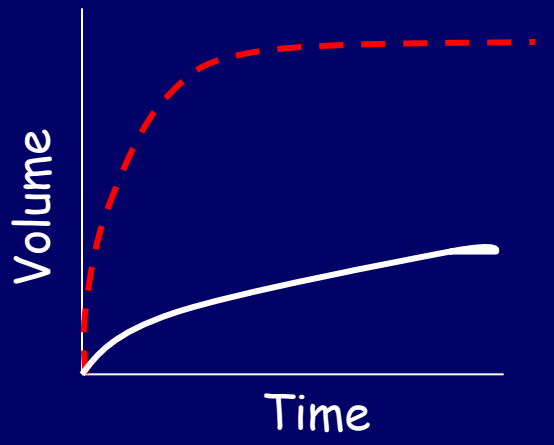
Slow rise, reduced volume expired; prolonged time to full expiration

Restrictive



Fast rise to plateau at reduced maximum volume

Mixed



Slow rise to reduced maximum volume; measure static lung volumes and full PFT's to confirm

PRACTICAL SESSION

Performing Spirometry

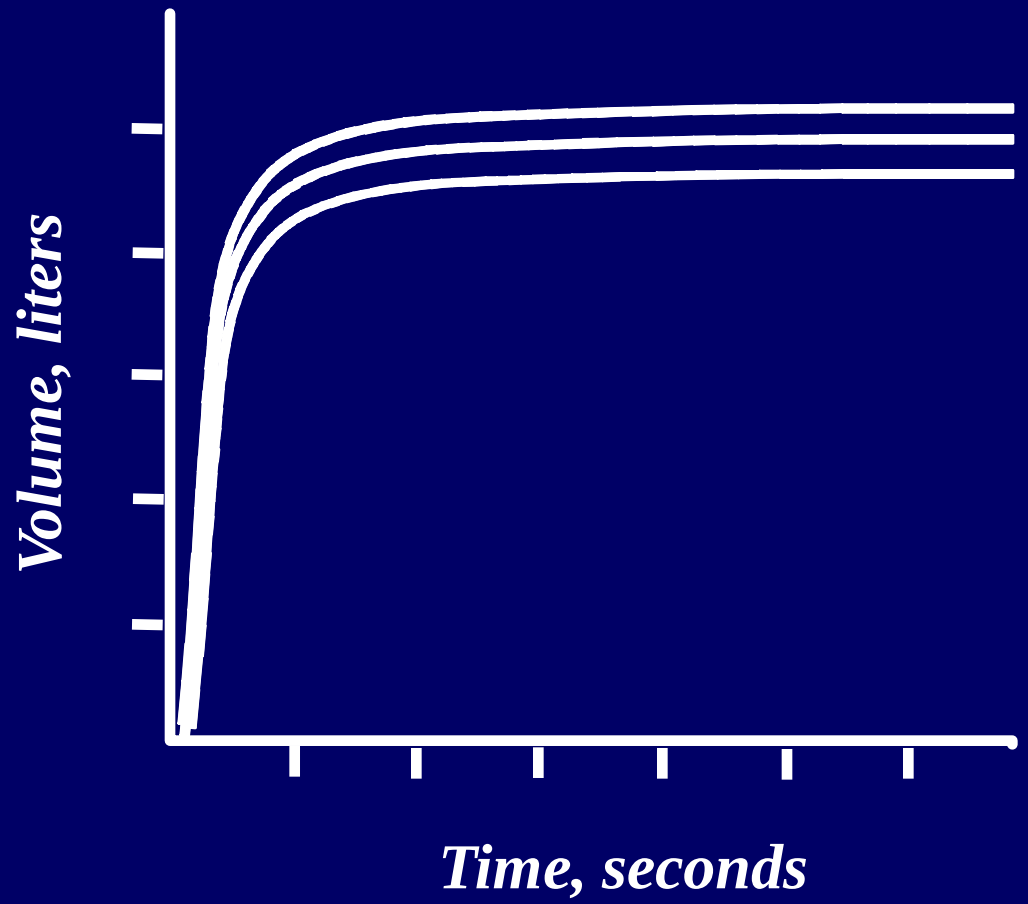
Performing Spirometry

- Breath in until the lungs are full
- Hold the breath and seal the lips tightly around a clean mouthpiece
- Blast the air out as forcibly and fast as possible. Provide lots of encouragement!
- Continue blowing until the lungs feel empty

Performing Spirometry

- Watch the patient during the blow to assure the lips are sealed around the mouthpiece
- Check to determine if an adequate trace has been achieved
- Repeat the procedure at least twice more until ideally 3 readings within 100 ml or 5% of each other are obtained

Reproducibility - Quality of Results

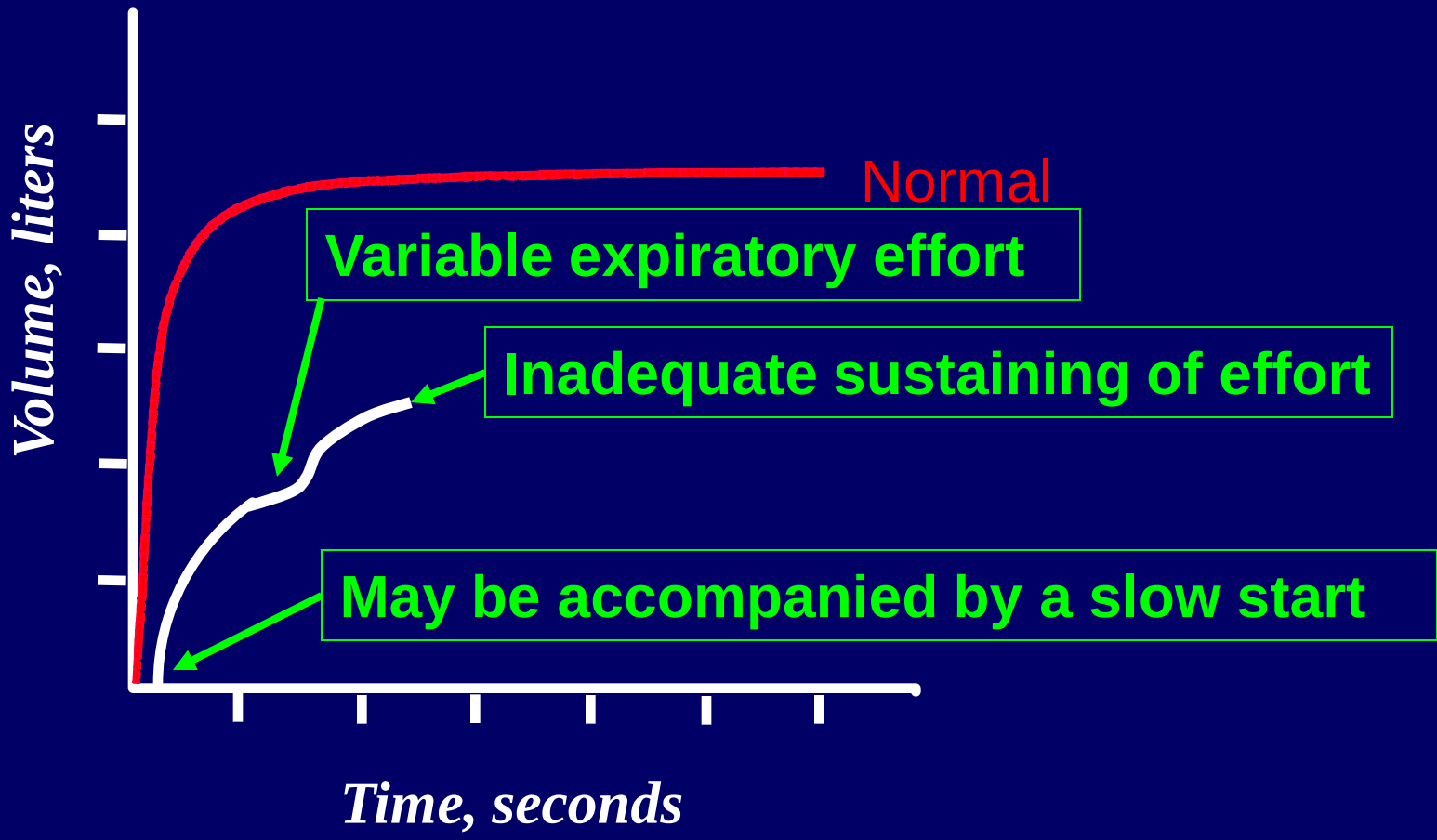


Three times FVC within 5% or 0.1 litre (100 ml)

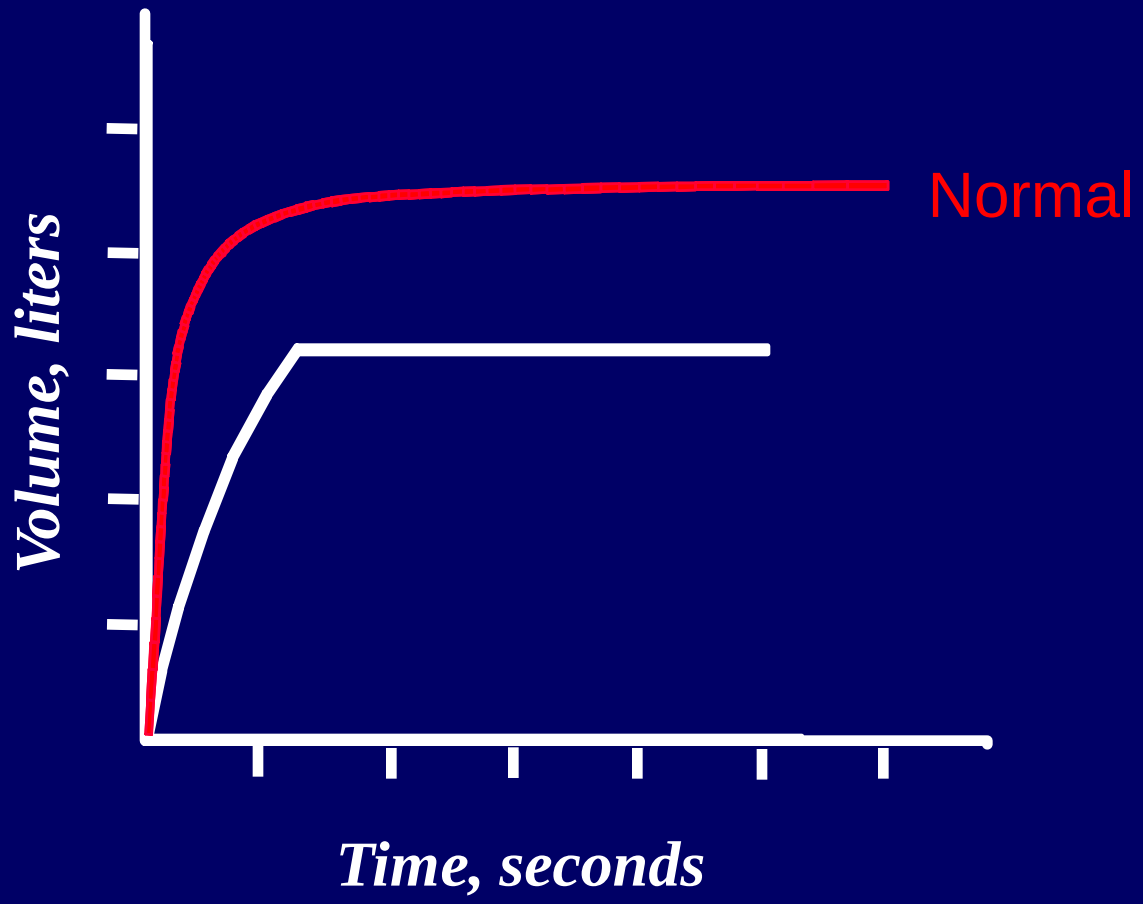
Troubleshooting

Examples - Unacceptable Traces

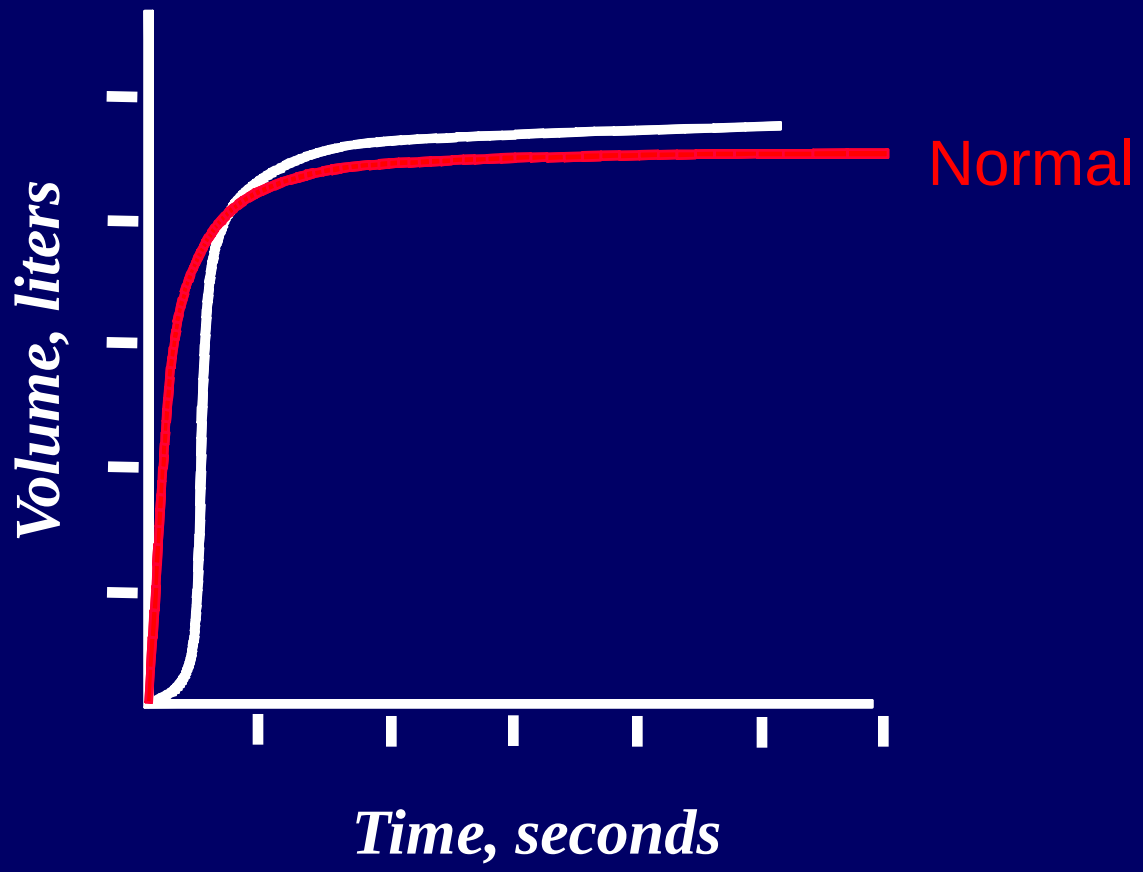
Unacceptable Trace - Poor Effort



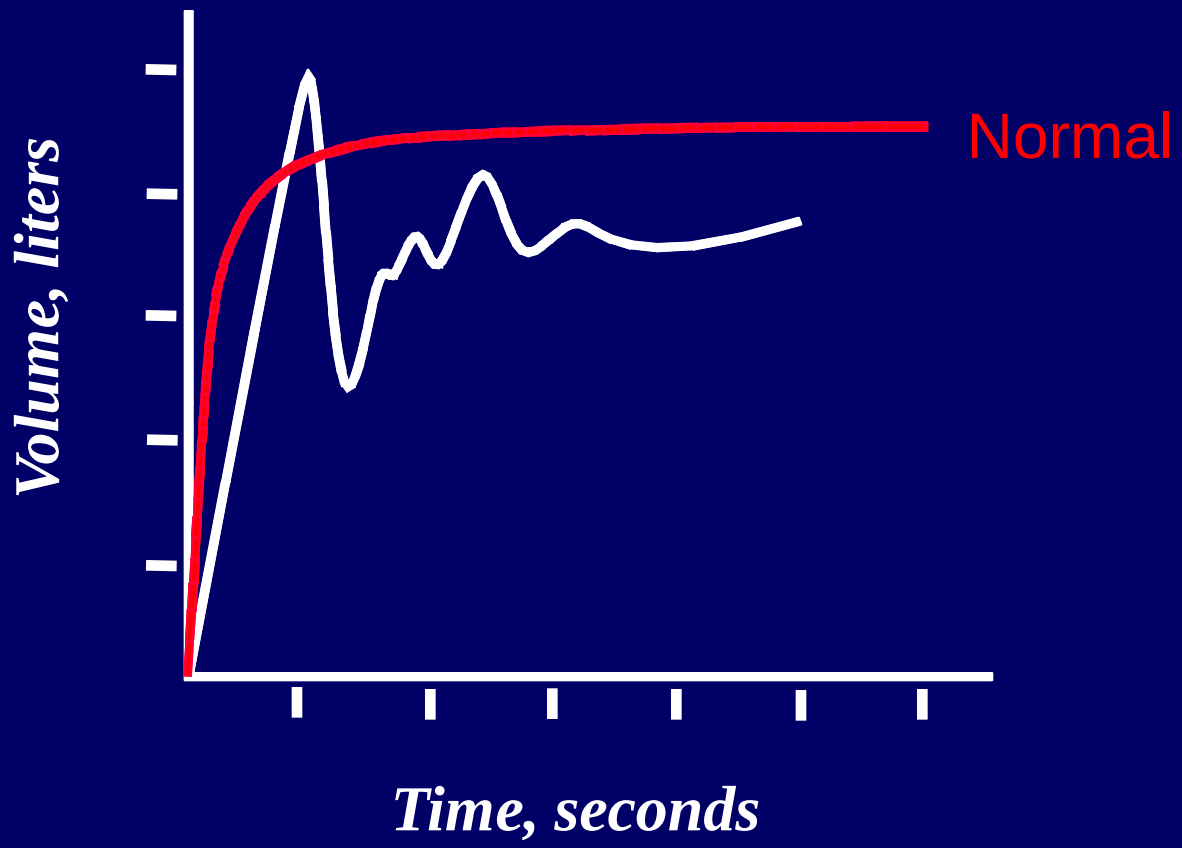
Unacceptable Trace – Stop Early



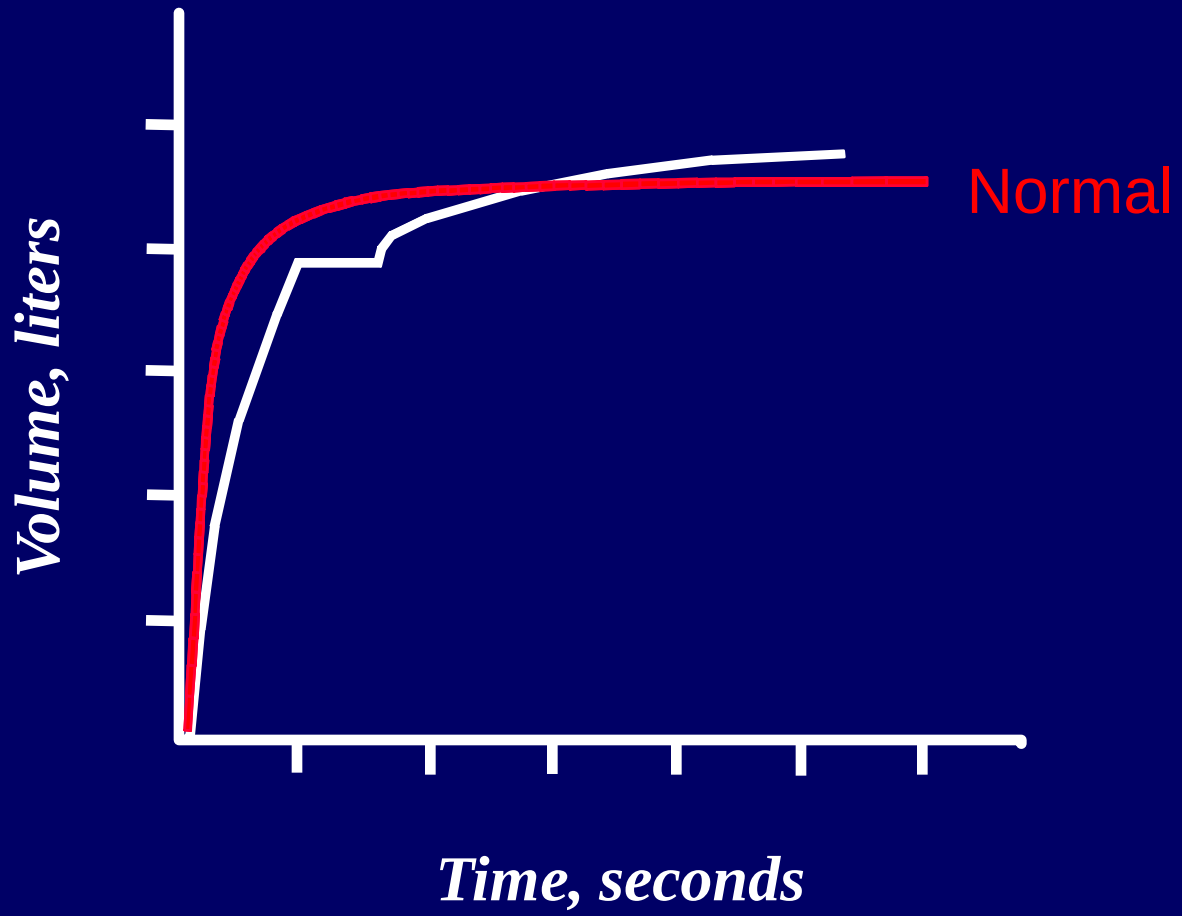
Unacceptable Trace – Slow Start



Unacceptable Trace - Coughing



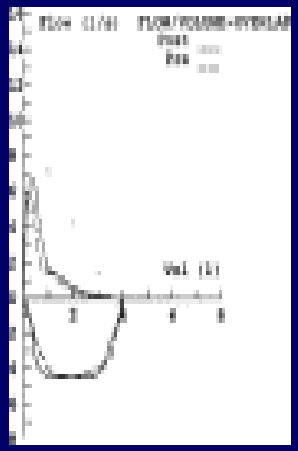
Unacceptable Trace – Extra Breath



Spirometry – Common Problems

- ✓ Inadequate or incomplete blow
- ✓ Lack of blast effort during exhalation
- ✓ Slow start to maximal effort
- ✓ Lips not sealed around mouthpiece
- ✓ Coughing during the blow
- ✓ Extra breath during the blow
- ✓ Glottic closure or obstruction of mouthpiece by tongue or teeth
- ✓ Poor posture – leaning forwards

COPD butPEF normal: Following figure



Following figure

- represents a typical flow–volume loop from a patient with moderately severe COPD, but with a relatively preserved PEF measurement as is often the case. If relying on PEF measurement alone, the severity of disease would have been grossly underestimated

•Plethysmography

قيم تزداد في الانتفاخ وتقل في التليف

- Residual volume: air trapped in lungs after full expiration

❑ RFC: fom Tidal volume after normal Expiration

❑TLUNG CAPACITY:

DLCO

- انتشار أول أوكسيد الكاربون : الجدار السنخي الوعائي هو المسرح
  ينقص في التليف والانتفاخ

Compliance: مطاوعة

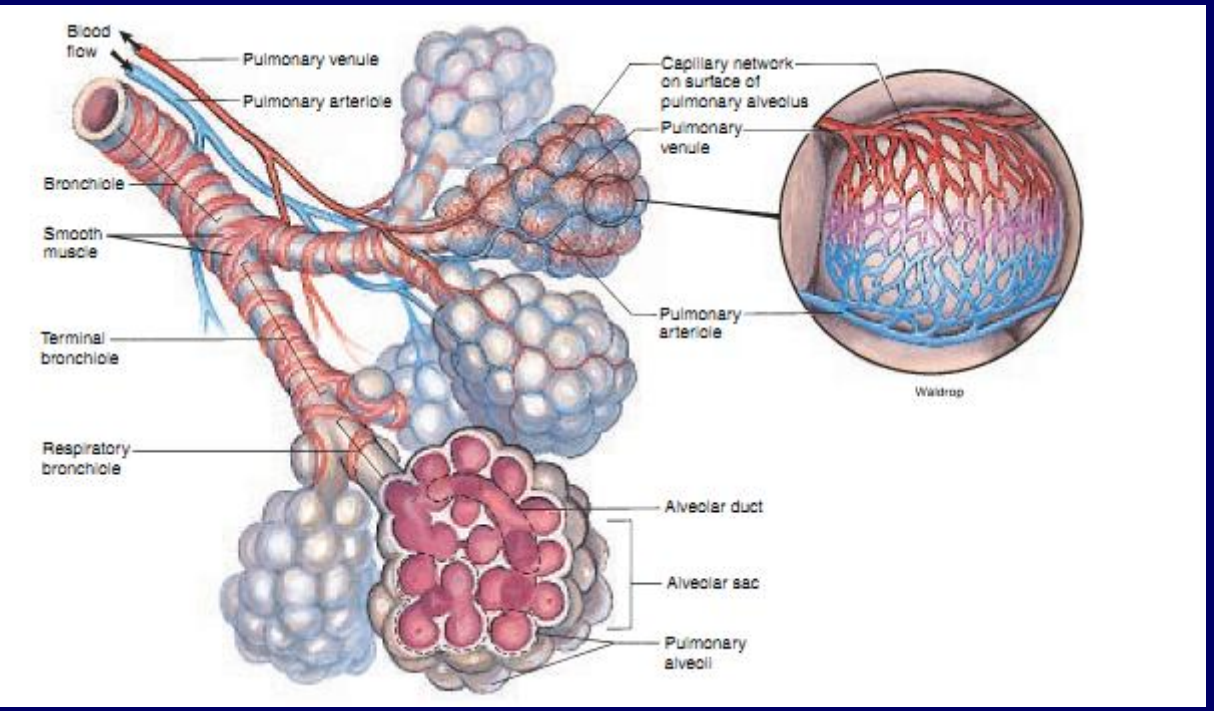
- تخف في تليف الرئة وتزداد في الانتفاخ

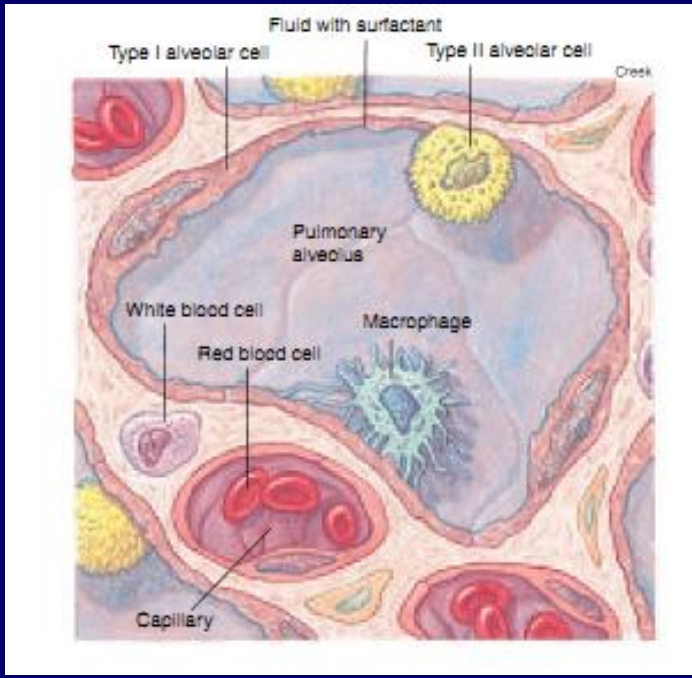
Airway resistance

- High in COPD

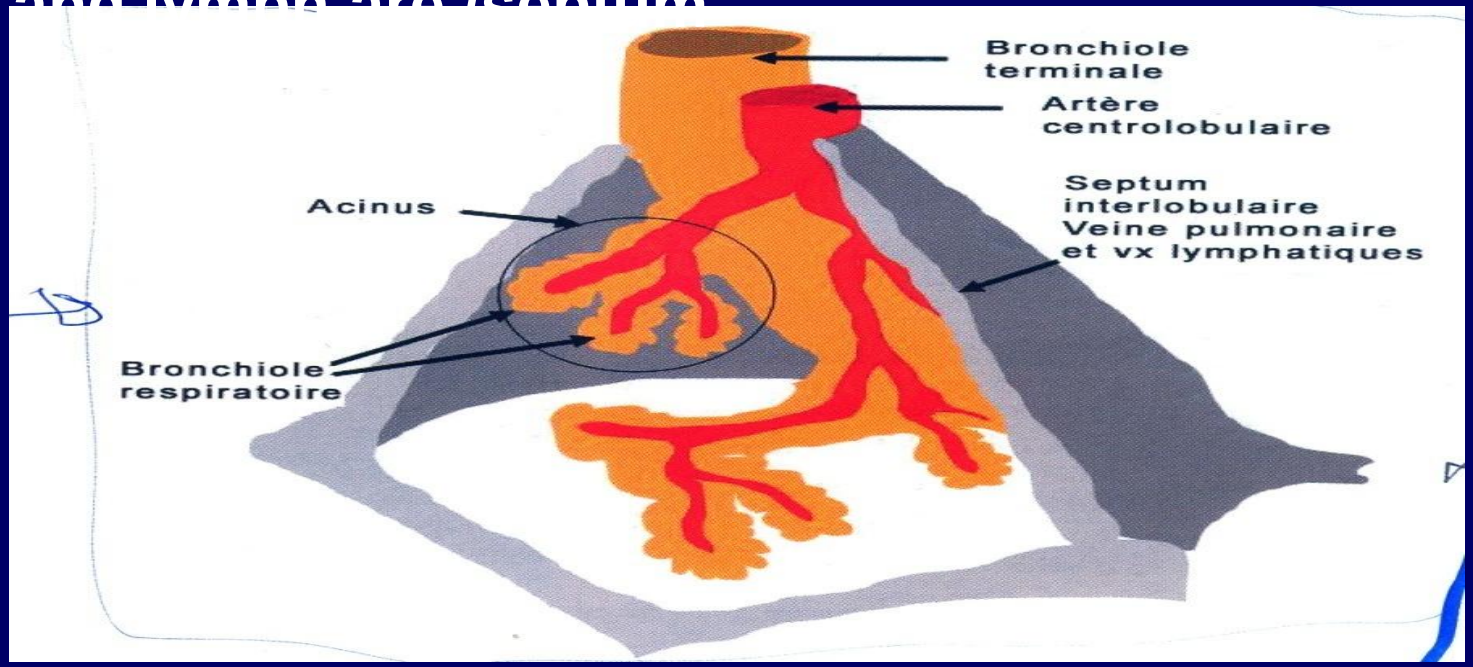
غازات الدم

الجهاز التنفسي(تبادل غازي)
Respiratory System





A rtery and bronchiols are central, veines and lymph are /septum



انتقال الهواء

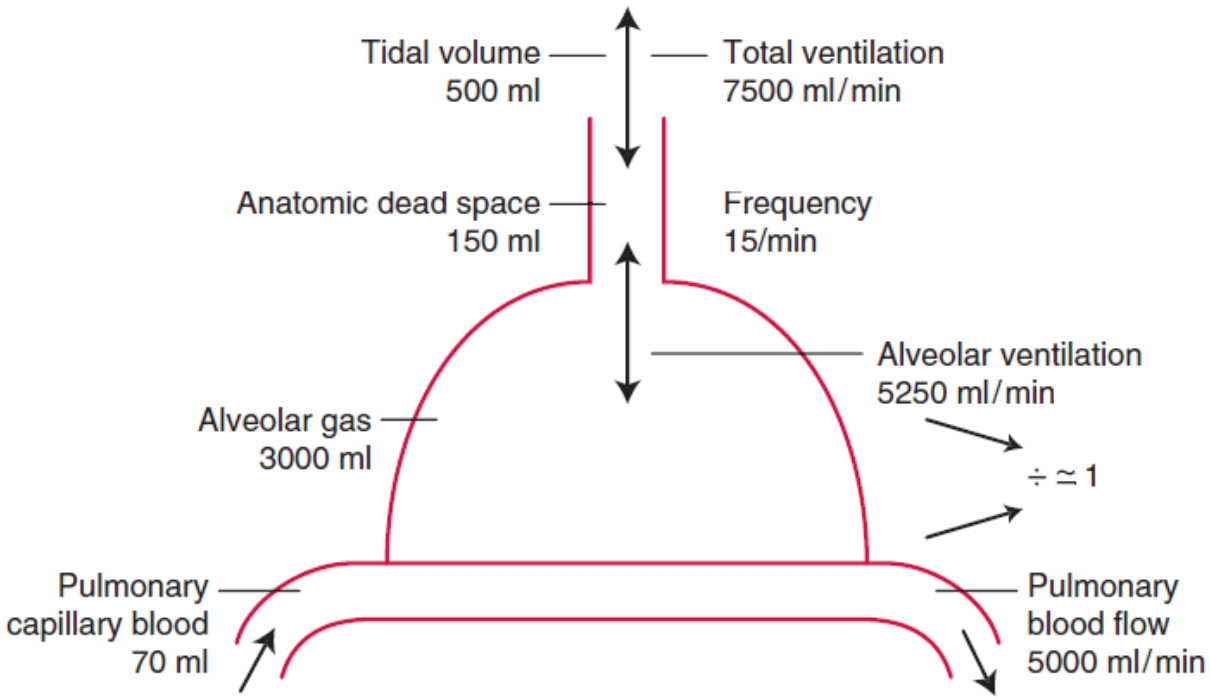


Figure 2-1. Diagram of a lung showing typical volumes and flows. There is considerable variation around these values.

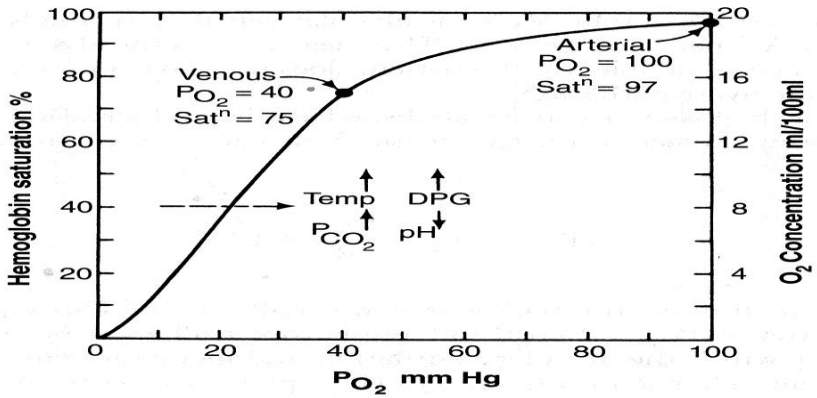


Figure 2.2. Anchor points of the oxygen dissociation curve. The curve is shifted to the right by an increase in temperature, P_{CO_2}, 2,3-DPG, and a fall in pH. The oxygen concentration scale is based on a hemoglobin concentration of 14.5 g/100 ml.

Causes of Hypoxemia

There are four primary causes of a reduced P_{O_2} in arterial blood:

1. Hypoventilation
2. Diffusion impairment
3. Shunt
4. Ventilation–perfusion inequality

A fifth cause, reduction of inspired P_{O_2}, such as during residence at high altitude or breathing a mixture of low oxygen concentration, is seen only in special circumstances.

Hypoventilation

This means that the volume of fresh gas going to the alveoli per unit time (alveolar ventilation) is reduced. If the resting oxygen consumption is not correspondingly reduced, hypoxemia inevitably results. Hypoventilation is commonly caused by diseases outside the lungs; indeed, very often the lungs are normal.

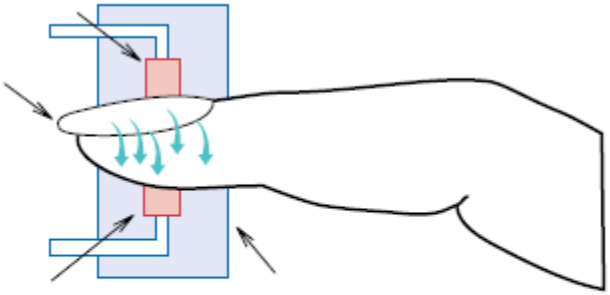
Two cardinal physiologic features of hypoventilation should be emphasized. First, it *always* causes a rise in P_{CO_2} and this is a valuable diagnostic feature. The relationship between the arterial P_{CO_2} and the level of alveolar ventilation in the normal lung is a simple one:

$$P_{CO_2} = \frac{\dot{V}_{CO_2}}{\dot{V}_A} \cdot K \qquad \text{(Eq. 2.1)}$$

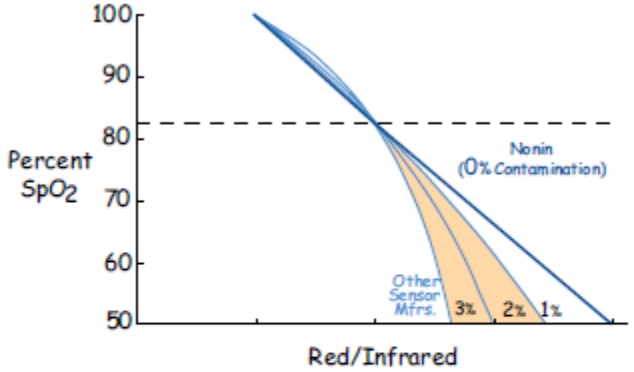
Pao2 of≤ 60 mmhg is the cut point for


Oxygen
Saturation
Pulse Rate

آلية عمله



a. A pulse oximeter noninvasively measures oxygen saturation by shining light through a digit or earlobe.



b. The ratio of red to infrared light yields the oxygen saturation, or SpO_2.

لماذا نستعمله

1. عند مريض الداء الرئوي الانسدادي المزمن في وضعه المستقر. فاذا كان SPO2< 88-92% نجر غازات الدم للتاكد من عدم وجود ارتفاع غير معاوض في ال CO2 وبالتالي انخفاض في PH مهدد باضطراب النظم البطيني، وبالتالي حاجة لاستقصاء وعلاج وقد يكون حتى أوكسجين مديد
2. عند مريض الداء الانسدادي مع سورة حادة : كذلك هذه الارقام تشير لقصور تنفسي حاد وحاجة للأوكسجين
3- عند مريض الربو يفيد مع البيك فلو في تحديد شدة النوبة وبالتلي، حاجة لأوكسجين في حال SPO2<92%
4- في أي حالة اسعافية

الاستعمال

- نتركه على الاصبع حتى يستقر الرقم بدون اسراع
- اذا وضعنا المريض على أوكسجين بنسبة مئوية معيبة، ننتظر ربع الى نصف ساعة قبل اعادة قراءة الرقم كي يتوازن
- الرقم المقروء هو أوكسيهيموغلوبين/كاربوكسيهيموغلوبين

Limitation of pulse oxymetry

- طلاء الأظافر
- اللون الأسود للبشرة
- التسمم بال Coحيث يبقى الاشباع طبيعي
- فقر الدم حيث يبقى الاشباع طبيعي

استعمال الأوكسجين الأنفي

- في الحالات الحادة وعندما يكون هناك قصور تنفسي حاد SPO2< 92%
- في حال كونه أقل من 92% يعطى أوكسجين أنفي بالقنية أو القناع. ويراقب التحسن بعد ربع ساعة .
- اذا كان مريض داء انسدادي نعطيه 1 ليتر أوكسجين في الدقيقة كبداية ونراقب الاشباع بعد نصف ساعة .ونحوله للمشفى اذا لم يتحسن لاجراء غازات الدم
- أذا كان مريض ربو نعطيه 6ليتر في الدقيقة , بسبب وجود الوزمة والسدادات المخاطية

نجر غازات الدم في حال نقص اشباع

القيم الطبيعية لغازات الدم

الشرياني:

- PaO2: 95 mmhg , range 85-100
- PaCO2, 37-42
- PH7.38,7.42
- اشباع الأوكسجين> 95%- 97%

الوريدي:

Saturation 75% , PvO2= 40mmhg