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المحاضرة الخامسة- المرحلة الثانية
الطب الباطني- تقنيات التخدير

pulmonary function test(PFT)
ARTERIAL BLOOD GASES(ABG)
POLYSOMNOGRAPHY(PSG)

Respiratory function tests

The main clinical roles of respiratory function tests include **diagnosis**, **assessment of severity**, **monitoring treatment** and **evaluation of prognosis**.

Spirometry

Spirometry : is the most important function test –

it measures vital capacity (VC) and forced expiratory volume in 1 second (FEV1).

This permits differentiation between restrictive and obstructive respiratory diseases.

These tests are used to measure the effect of bronchodilating drugs on reversibility of obstruction as well as to determine responsiveness to bronchial provocation tests.

Simple instruments for patient home use include **peak flow meters**, which measure the degree of obstruction.

Normal Values

- **FVC**
  - **80 – 120% of predicted is a normal value**
  - **70 – 80% demonstrates mild reduction/restriction**
  - **50 – 70% demonstrates moderate reduction**
  - **<50% demonstrates severe reduction**

Normal Values

- FEV_1
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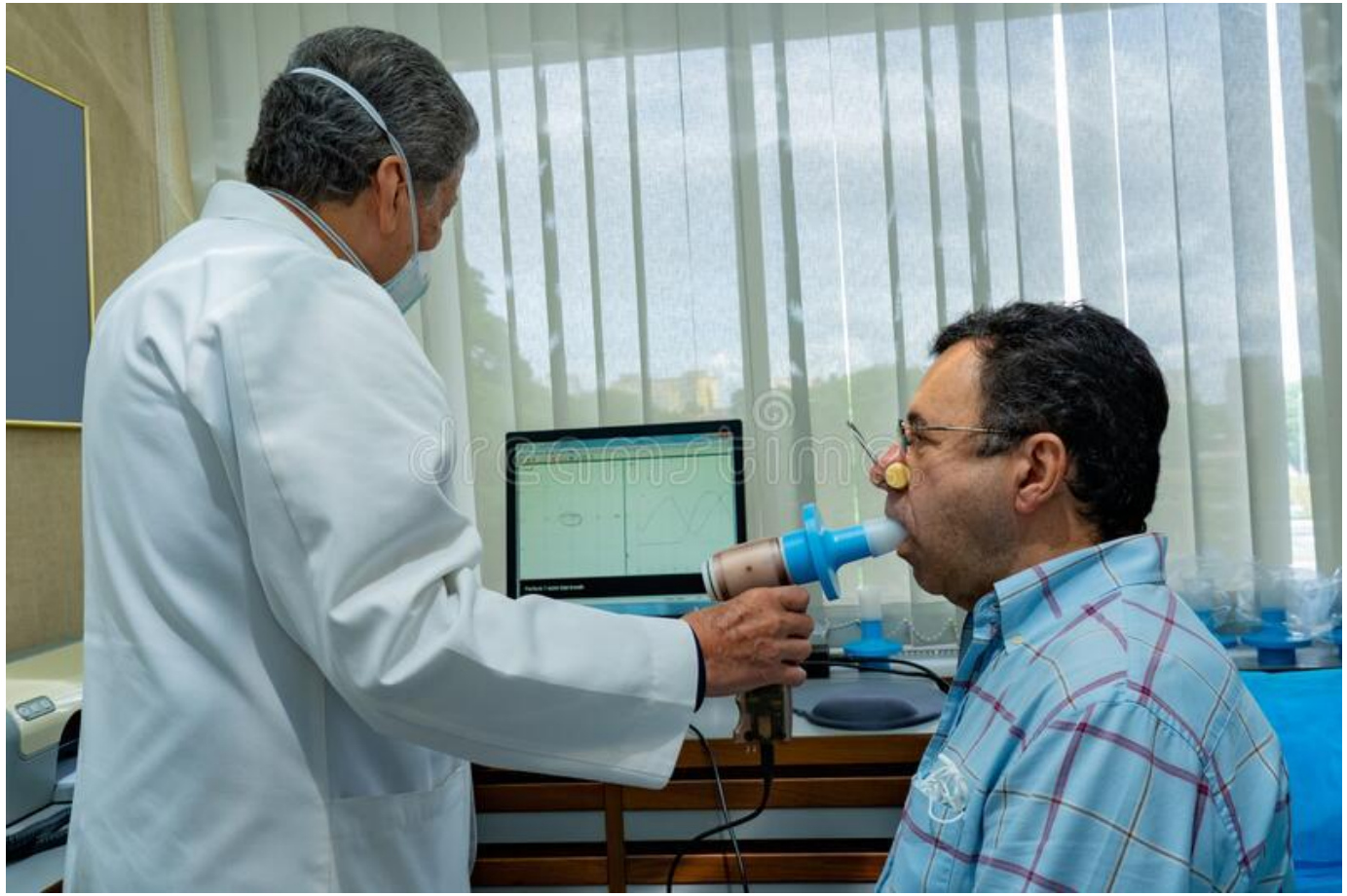
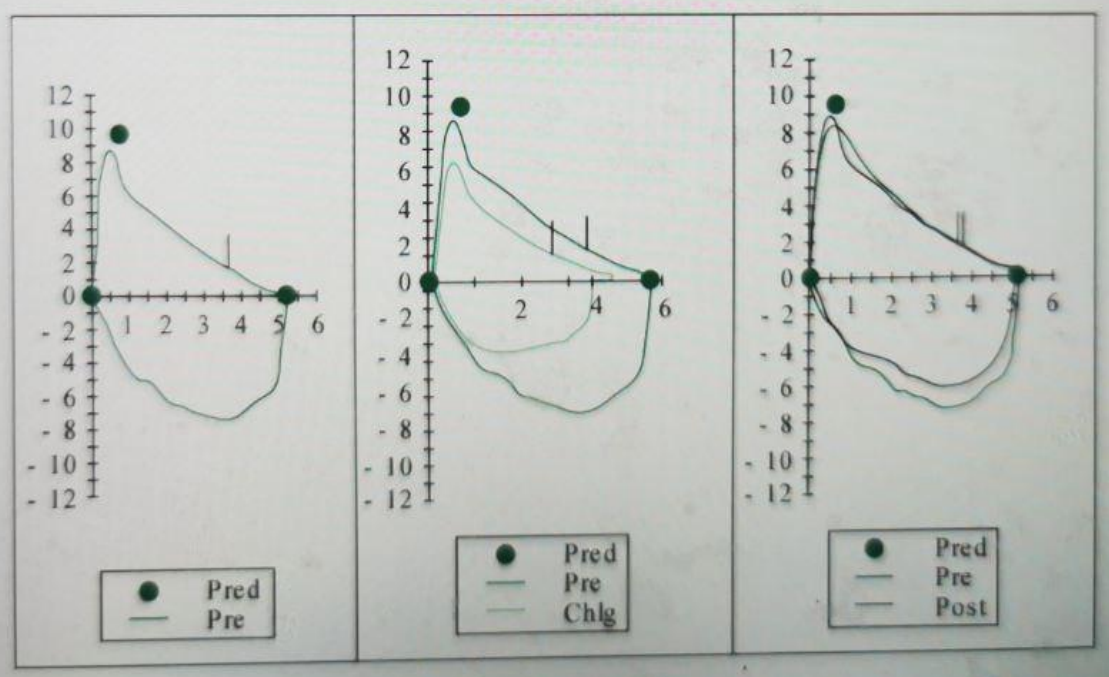


Example of pft

	BASELINE		MAX RESPONSE		Post-BD		
	Pred	Actual	%Pred	Actual	%Chng	Actual	%Chng
—SPIROMETRY—							
FVC (L)	5.05	5.20	102	4.38	- 15	5.30	+2
FEV_1 (L)	4.20	3.69	87	2.86	- 22	3.79	+2
FEF 25–75% (L/sec)	4.45	2.67	59	1.06	- 60	2.85	+6
FEF max (L/sec)	9.52	8.73	91	6.34	- 27	8.30	- 4



Blood gas analysis

- **Arterial blood gas (ABG)** measurement to determine the arterial oxygen tension (PaO_2) and arterial carbon dioxide tension ($PaCO_2$) is one of the most useful diagnostic tests: blood can be sampled directly from an **artery**, ABG measurement allows the diagnosis of **hypoxaemia** (decreased PaO_2) with or without **hypercapnia** (increased $PaCO_2$)

ABG measurement also allows evaluation of acid–base disorders.

The 6 Easy Steps to basic ABG Analysis:

1. Is the pH normal? Acidic or Alkaline?
2. Is the pCO_2 normal? Acidic or Alkaline?
3. Is the HCO_3 normal? Acidic or Alkaline?
4. Match the CO_2 or the HCO_3 with the pH
5. Does the CO_2 or the HCO_3 go the opposite direction of the pH?
6. Are the pO_2 and the O_2 saturation normal?

Step 1: Analyze the pH •

Normal blood pH is 7.4 (range 7.35 to 7.45). •

pH < 7.35 → acidic. •

pH > 7.45 → alkaline. •

If it falls into the normal range, label what side of 7.4 it falls on. •
Lower than 7.4 is normal/acidic, higher than 7.4 is normal/alkalotic.

Step 2: Analyze the pCO_2 :

- ***Normal pCO_2 levels = 35-45mmHg.***
- ***Below 35 is alkaline,***
- ***Above 45 is acidic.***

Step 3: Analyze the HCO3: •

Normal HCO3 level is 22-26 mEq/L. •

If the HCO3 is below 22, the patient is acidotic. •

If the HCO3 is above 26, the patient is alkalotic •

Step 4: Match the CO_2 or the HCO_3 with the pH

- ***If the pH is acidotic, and the CO_2 is acidotic, then the acid-base disturbance is being caused by the respiratory system.***

  Therefore, we call it a respiratory acidosis.

- ***However, if the pH is alkalotic and the HCO_3 is alkalotic, the acid-base disturbance is being caused by the metabolic (or renal) system. Therefore, it will be a metabolic alkalosis.***

Step 5: Does the CO_2 or HCO_3 go the opposite direction of the pH?

- ***If so, there is compensation by that system.***
- ***For example, the pH is acidotic, the CO_2 is acidotic, and the HCO_3 is alkalotic: The CO_2 matches the pH making the primary acid-base disorder respiratory acidosis. The HCO_3 is opposite of the pH and would be evidence of compensation from the metabolic system.***

Step 6: Analyze the pO2 and the O2 saturation. •

If they are below normal there is evidence of hypoxemia. •

- **NORMAL VALUES:**

pH	7.35-7.45
pCO2	35-45 mmHg
pO2	80-100 mmHg
O2 Saturation	95-100%
HCO3-	22-26 mEq/L
Base Excess	+ or - 2

- Interpretation of Values:

Test	Normal	↓ Value	↑ Value
pH	7.35-7.45	Acidosis	Alkalosis
pCO2	35-45	Alkalosis	Acidosis
HCO3	22-26	Acidosis	Alkalosis
pO2	80-100	Hypoxia	Hyperoxia
SaO2	95-100%	Hypoxemia	———

Sample type	Arterial		
$FO_2(I)$	100.0 %		
Location	[redacted]		
Note			

Blood Gas Values

↓ pH	6.956		[7.350 - 7.450]
↑ pCO_2	155	mmHg	[35.0 - 45.0]
↓ pO_2	35.0	mmHg	[75.0 - 100]

Acid Base Status

$cHCO_3^-(P.st)_c$	22.5	mmol/L	
$cBase(B)_c$	-1.5	mmol/L	[-3.0 - 3.0]

Electrolyte Values

↑ cK^+	5.7	mmol/L	[3.4 - 5.5]
cNa^+	144	mmol/L	[136 - 146]
cCa^{2+}	1.30	mmol/L	[1.15 - 1.30]
? $cCa^{2+}(7.4)_c$		mmol/L	
↑ cCl^-	107	mmol/L	[94 - 107]

Metabolite Values

↑ cGlu	10.2	mmol/L	[3.9 - 5.8]
cLac	1.2	mmol/L	[0.5 - 2.0]

Oxygen Status

↓ ctHb	81	g/L	[130 - 180]
↓ sO_2	46.0	%	[95.0 - 100.0]
$p50_c$	37.16	mmHg	
$pO_2(a/A)_e$	6.3	%	
FMetHb	0.1	%	[0.0 - 1.5]
FCOHb	1.2	%	[0.0 - 1.5]
$p50(st)_c$	22.64	mmHg	
$FShunt_e$	59.4	%	
FO_2Hb	45.4	%	[-]
Hct_c	25.2	%	

Diagnosis of sleep breathing disorders

- The diagnosis of sleep-related respiratory disorders requires special tests. The gold standard is polysomnography (PSG), but simpler tests are available for screening purposes (‘respiratory polysomnography’).
- For **diagnosis of sleep apnea syndrome**

PSG test

Example of PSG

Sample PSG Report

- Events by sleep stage & position

Respiratory Summary – Pre-Treatment:

Types of Respiratory Events		
Respiratory Events	**Number**	**Index**
Obstructive Apneas	65	22.3 /hr
Mixed Apneas	0	0.0 /hr
Central Apneas	0	0.0 /hr
Total Apneas	**65**	**22.3 /hr**
Total Hypopneas*	**48**	**16.5 /hr**
Apneas + Hypops*	**113**	**38.9 /hr**

Respiratory Effort Related Arousal (RERA) Events		
Parameter	**Total**	**Index**
Total:	24	8.3
Non-REM:	23	8.3
REM:	1	6.7
Supine:	24	8.3
Lateral:	N/A	N/A
Prone:	N/A	N/A

Oxygen Saturation Summary – Pre-Treatment:

Mean SaO2:	95.2%	Lowest SaO2:	79.0%
% TST SaO2 < 90%:	2.3%	# Desaturation 4% or >:	91
% TST SaO2 < 89%:	1.7%	Desaturation Index:	31.3
Minutes SaO2 < 90%:	4.0	NREM Desaturations Index:	28.6
Minutes SaO2 <= 88%:	5.5	REM Desaturations Index:	80.0

- AHI < 5/h normal
- AHI 5-15/h MILD
- AHI 15-30/h MODERATE
- AHI> 30/h sever

Thank you•