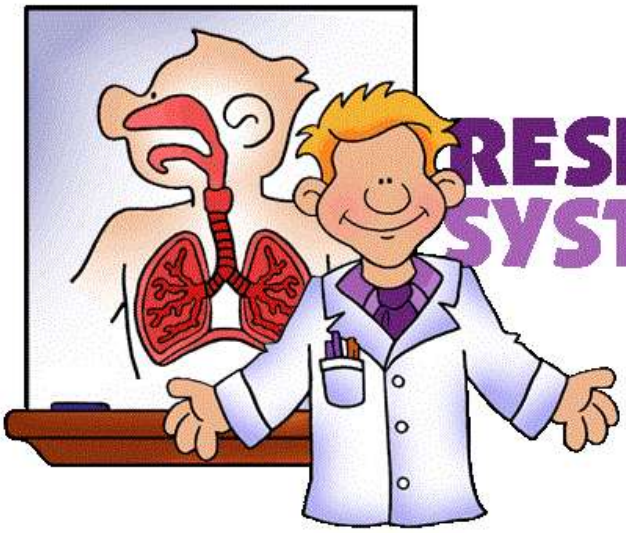
Physiology Team 432



1st + 2nd Lectures

Practical Physiology Handout

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1434- 2013

Everything here is important but the MOST important things are colored in RED

RESPIRATION PRACTICALS
BELL – TYPE SPIROMETRY

OBJECTIVES:

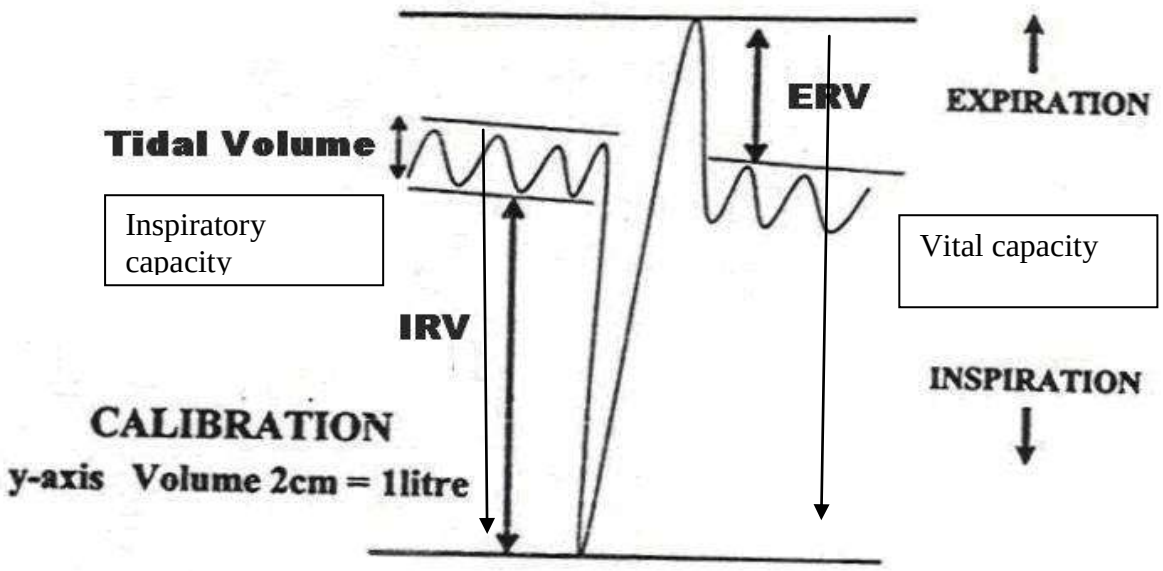
To be able to:-
a) use a spirometer and-determine lung volumes and capacities
b) define and provide normal values for the various lung volumes and capacities and
c) recognize the physiological and some pathological factors that modify lung volumes and capacities

APPARATUS:

A variety of spirometers are currently available. A diagram of one of them is presented in the figure.

هنا تعرفون اماكن الـ Volumes والـ Capacity (التعريف والقيم الطبيعية)

RESULTS:



QUESTIONS AND PROBLEMS:

1. Define the following terms and calculate their values from the data collected:-
   a) Tidal volume:

      It is the volume of air inspired or expired during quiet (normal) breathing.
      Its normal value is 500 ml or 0.5 Liter.

   b) Inspiratory Reserve Volume:

      It is the volume of air that can be maximally inhaled after normal inspiration.
      Its normal value is 3000 ml or 3 Liters.

   c) Expiratory Reserve Volume:

      It is the volume of air that can be maximally exhaled after normal expiration.
      Its normal value is 1100 ml or 1.1 Liters.

d) Vital Capacity:

It is the volume of air that can be maximally expired after maximum inspiration. Its normal value is 4600 ml or 4.6 Liters.

e) Inspiratory Capacity:

It is the volume of air that can be maximally inhaled after normal expiration. Its normal value is 3500 ml or 3.5 Liters.

2. A number of physiological factors influence lung volumes and capacities. What are they and how do they exert their effects?

- ✓ **Age**
- ✓ **Height**
- ✓ **Weight**
- ✓ **Gender**
- ✓ **Posture**
- ✓ **Pregnancy**

3. Lung volumes and capacities are altered in a variety of pathological conditions. Name a few of them and explain how these changes are produced.

- ✓ **Bronchial Asthma**
- ✓ **Pulmonary fibrosis**
- ✓ **Chest wall deformities**
- ✓ **Respiratory muscle weakness**

These are few examples of those conditions which can alter the lung volumes and capacities either by decreasing the lung compliance or by narrowing the airways.

4. What is the physiological significance of the Residual Volume and the Functional **Residual Capacity?**

- ✓ **They prevent the lungs from collapsing.**
- ✓ **They maintain a continuous gas exchange between the breaths.**
- ✓ **They make the work of breathing easier.**

5. Residual volume, total lung capacity and functional residual capacity cannot be directly measured by spirometry. What is the technique that can be used to measure it?

Helium dilution technique

RESPIRATION PRACTICALS
DYNAMIC SPIROMETRY
BY SCHILLER AT-2 PLUS

OBJECTIVE:

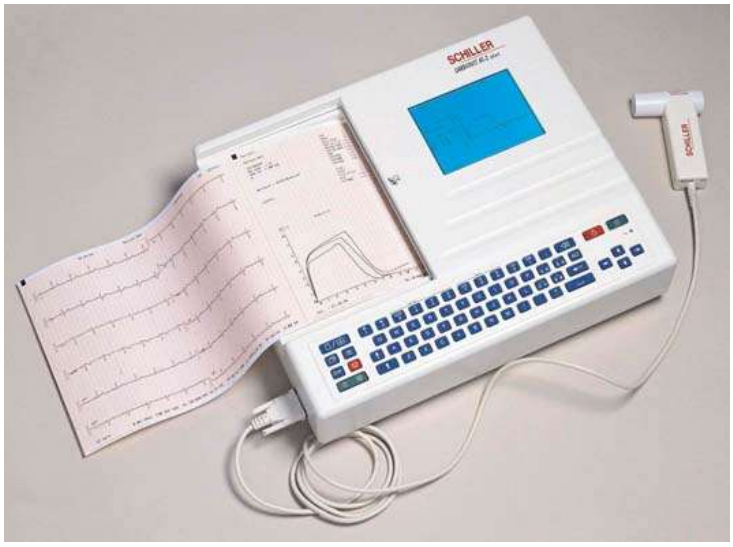
To test pulmonary functions e.g. Forced Vital Capacity (F.V.C.) measurements including FEV_1 and Flow Volume Curve.

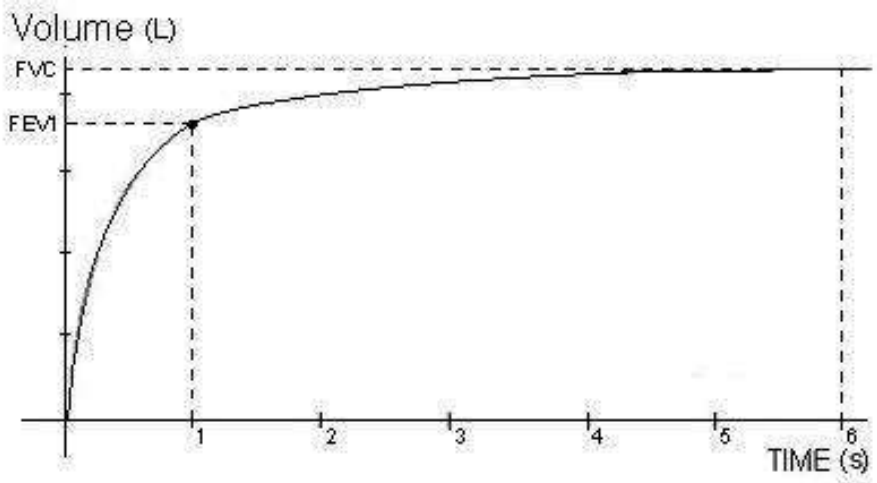
METHOD:

a- Insert a new disposable mouthpiece into the flow sensor (SP-250)
b- Hold the sensor in upright position.
c- Insert the mouthpiece in the oral cavity (mouth) and close the lips around the mouthpiece. Put the nose clip.
d- In the standing position breathe normally through mouthpiece 3 times, then inhale maximally and then exhale maximally as quickly as possible.

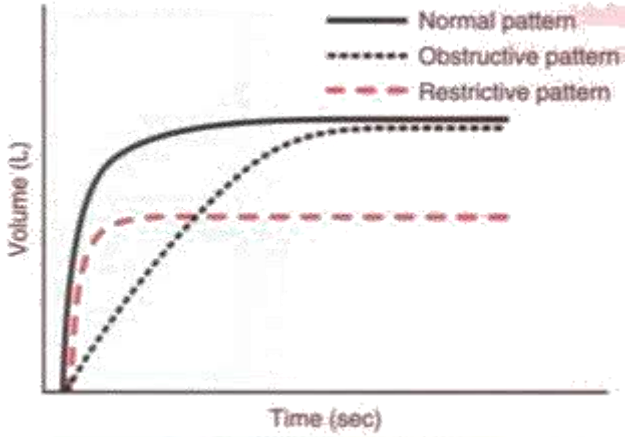
RESULTS:

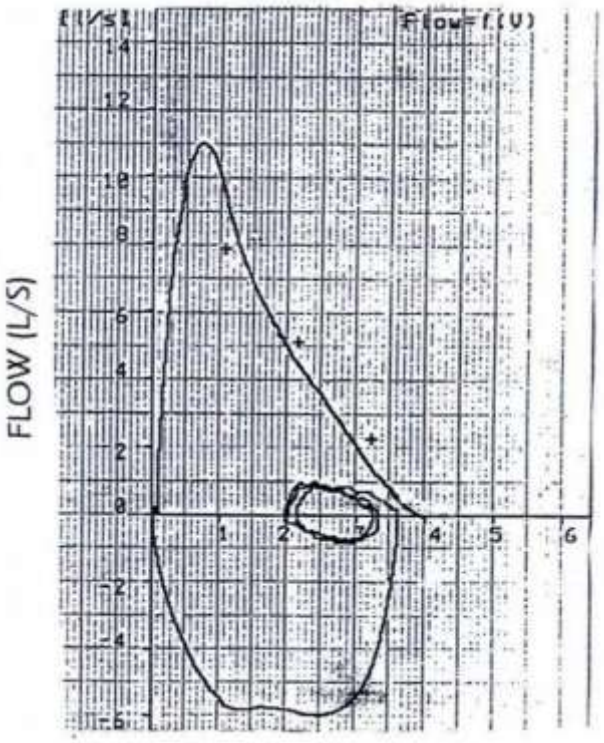
You will get the print out for the graph and values of FEV_1 and flow volume curve. Analyze these graphs yourself and compare your result with the data obtained by print out results from the AT-2 plus.





FEV_1 Curve





VOLUME (LITRES)

Flow – Volume Loop

QUESTIONS AND PROBLEMS

1. From the FEV_1 curve produced, calculate:-

a) **Forced vital capacity (FVC):** i.e. the volume of air expired with a forceful effort after a maximum inspiration

Look where the curve becomes straight line at the top, then take that straight line left towards the vertical axis where it shows the units in liters and see what value it is leading to and that will be your forced vital capacity (FVC).

b) **Forced expiratory volume in the first second (FEV_1):** i.e. the volume of air forcefully expired in the first second after maximum inspiration

X- axis of the FEV_1 curve represents the time duration of expiration in seconds. Mark the first second and draw an imaginary vertical line from this mark till it reaches the curve. From there on, draw an imaginary horizontal line towards the vertical axis and see the value to which it ends. That will be your FEV_1 value.

c) **$FEV1_{\%}$ = FEV1 x 100 / FVC**

2. The FEV1 % is a good index of airway resistance while expiring.

a) What values would be expected for a normal person?

70 – 80 %

b) How long does it take for healthy subjects to expire their vital capacities?

3 – 5 seconds

c) Briefly explain what happens to FVC, FEV_1 and FEV_1 % measurements in patients with obstructive and restrictive lung diseases.

	Normal	Obstructive	Restrictive
FVC	**> 75 % predicted**	**Normal or ↓**	**↓↓↓**
FEV_1	**> 75 % predicted**	**↓↓↓**	**Normal or ↓**
FEV_1 %	**70 – 80 %**	**< 70 %**	**> 80 %**

3. From the flow volume loop recorded, calculate:-

a) Forced vital capacity (FVC)

It is measured over the X-axis of the flow-volume loop.
Its value is determined by the decline of expiratory loop over X-axis. Just look at what value of X-axis, the expiratory loop falls; that will be your forced vital capacity (FVC).

b) The peak expiratory flow rate (PEFR)

It is measured over the Y-axis of the flow-volume loop.
It is the maximum flow speed that can be achieved during forceful expiratory effort. Look at the peak of the expiratory loop and draw an imaginary horizontal line towards Y-axis. The value at which this imaginary line crosses the Y-axis, that value will be your peak expiratory flow rate (PEFR). More than 6 is normal (6-12)

d) The MEF50 (maximum expiratory flow at 50% vital capacity)

It is the flow speed of air during forceful expiration at the 50 % of the vital capacity. First mark the 50% of the vital capacity on the X-axis. Then draw a vertical imaginary line till it meets the declining expiratory loop. From here on, draw a horizontal imaginary line towards left till it reaches the Y-axis. Look at the value of Y-axis, at which this line ends; that value will be your MEF50.

If mef50 is the only value that decreased (less than 4) that's mean obstructive

if all the values decreased that's mean restrictive

4. Briefly describe the important characteristics of the flow-volume curve recorded with a normal healthy person.

It has an upward expiratory loop and a downward inspiratory loop. The expiratory loop has a rising phase and a falling phase. The rising phase is force-dependent, as the air comes out with force from the larger airways due to the contraction of expiratory muscles. The falling phase is force-independent as the air comes out from the smaller airways without any force due to the elastic recoil of the lungs.

5. Why is the force-independent part of the expiratory loop curvilinear in obstructive lung disease?

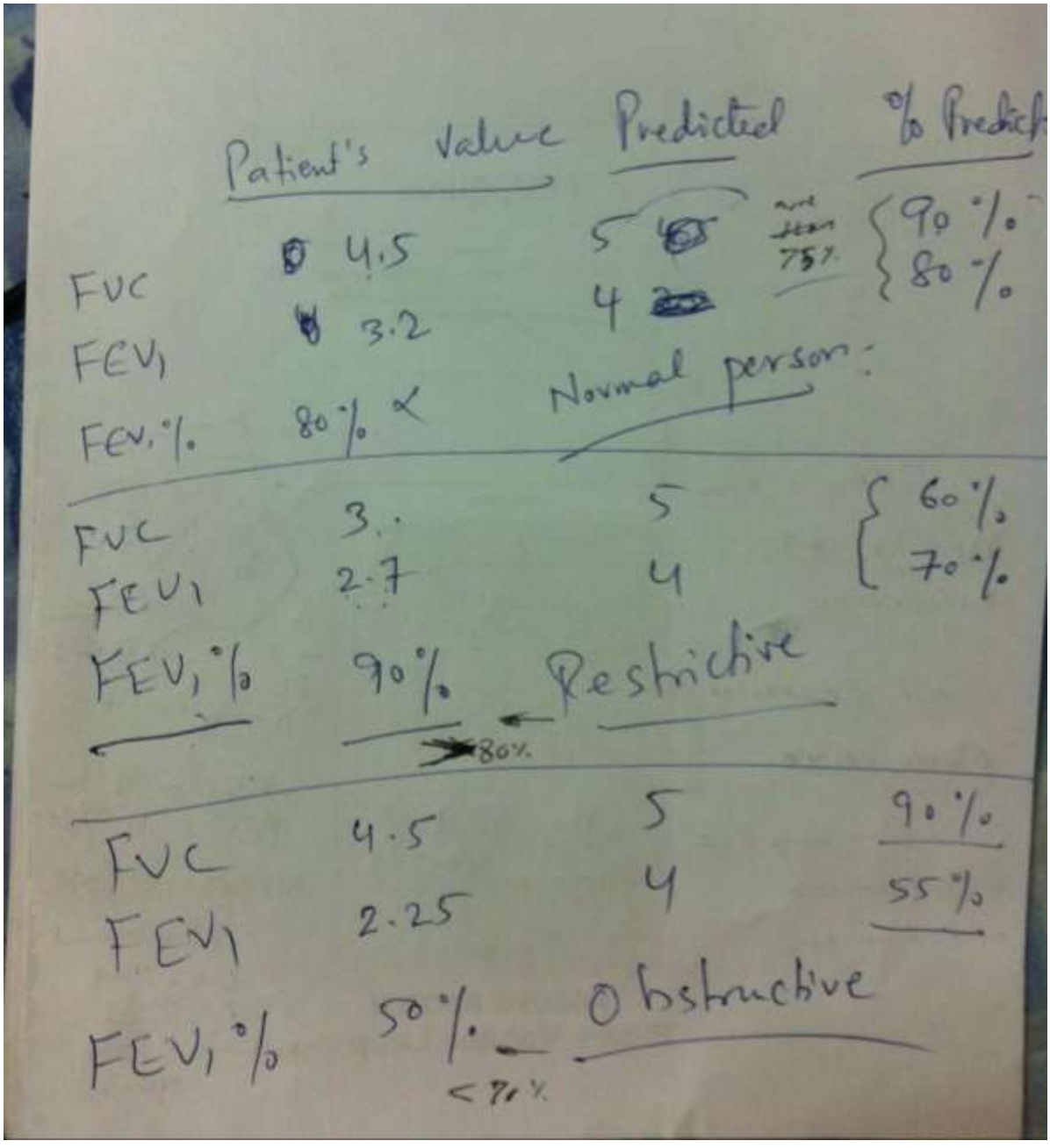
Because the smaller airways are narrowed due to either spasm or accumulation of secretions, they provide resistance to the airflow during expiration; therefore, the airflow slows down and the force-independent part of the expiratory loop becomes curvilinear.

6. What is the clinical significance of MEF50 measurements?

MEF50 becomes greatly reduced in obstructive lung diseases (less than 4 L/sec).
FVC is the Main marker for restrictive

Examples

To determine Restrictive, obstructive or normal person



Patient:

....

....

Age: .... M / F

..... cm / ..... kg

Normals : ECCS/Quanjer

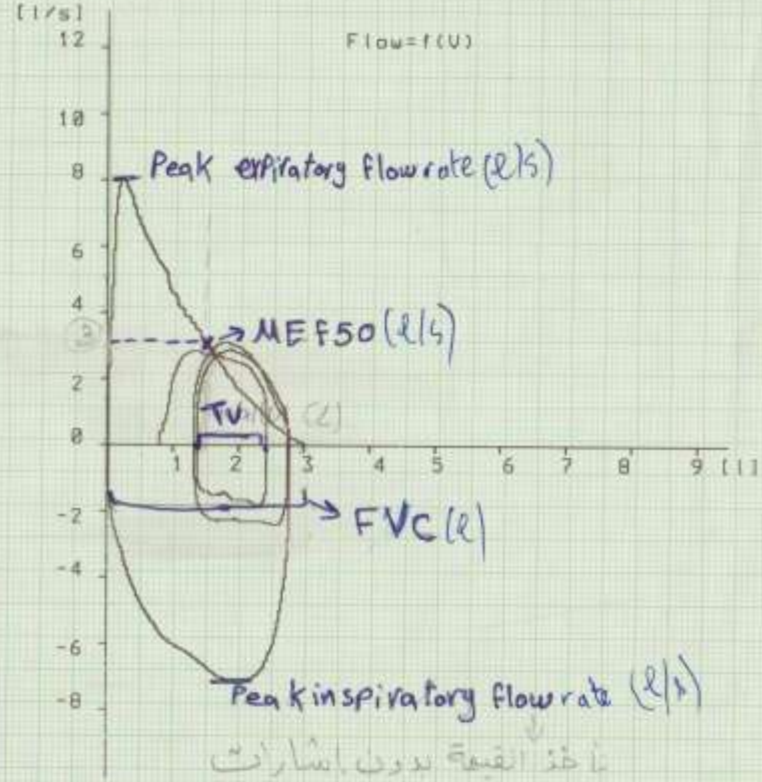
		BEST	PRED.	%PRED	MEAS1	MEAS2	MEAS3
FVC	l	3.00			3.00		
FEV1	l	2.53			2.53		
FEV1/FVC	%	84.3			84.3		
FEF.2-1.2	l/s	5.63			5.63		
FEF25-75%	l/s	2.62			2.62		
FEF75-85%	l/s	0.84			0.84		
PEF	l/s	7.82			7.82		
FEF25%	l/s	5.69			5.69		
FEF50%	l/s	3.07			3.07		
FEF75%	l/s	1.20			1.20		

Dynamic → اسم الجهاز

FEF50 = MEF50

أخذنا ½ الـ FVC ورسمنا خط // المحور ص

وتقاطع الخط مع المنحنى هو MEF50



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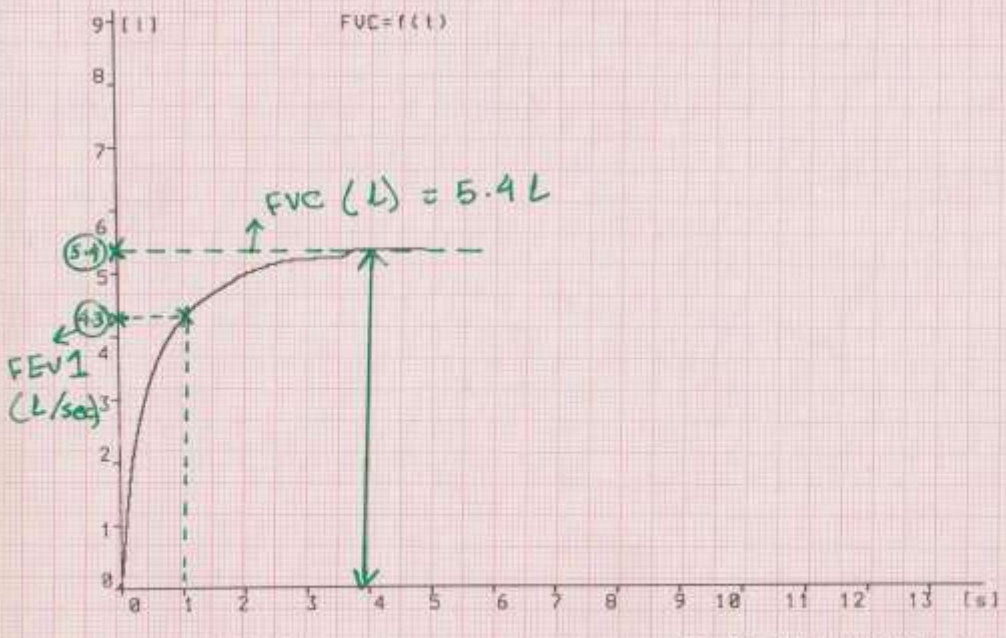
Patient:

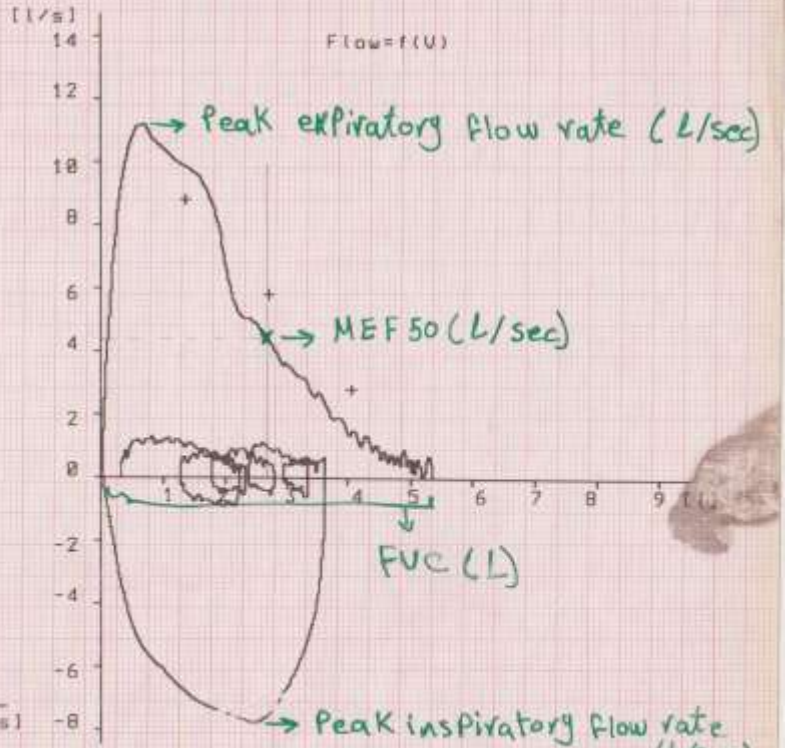
		BEST	PRED.	%PRED	MEAS1	MEAS2	MEAS3
FVC	l	5.36	5.54	97	5.36		
FEV1	l	4.21	4.65	91	4.21		
FEV1/FVC	%	78.6	82.7	95	78.6		
FEF.2-1.2	l/s	10.26			10.26		
FEF25-75%	l/s	3.71	5.18	72	3.71		
FEF75-85%	l/s	1.05			1.05		
PEF	l/s	10.99	10.33	106	10.99		
FEF25%	l/s	9.87	8.79	112	9.87		
FEF50%	l/s	4.39	5.82	75	4.39		
FEF75%	l/s	1.32	2.78	47	1.32		

Normals : ECCS/Quanjer

FEF50 = MEF50

NORMAL





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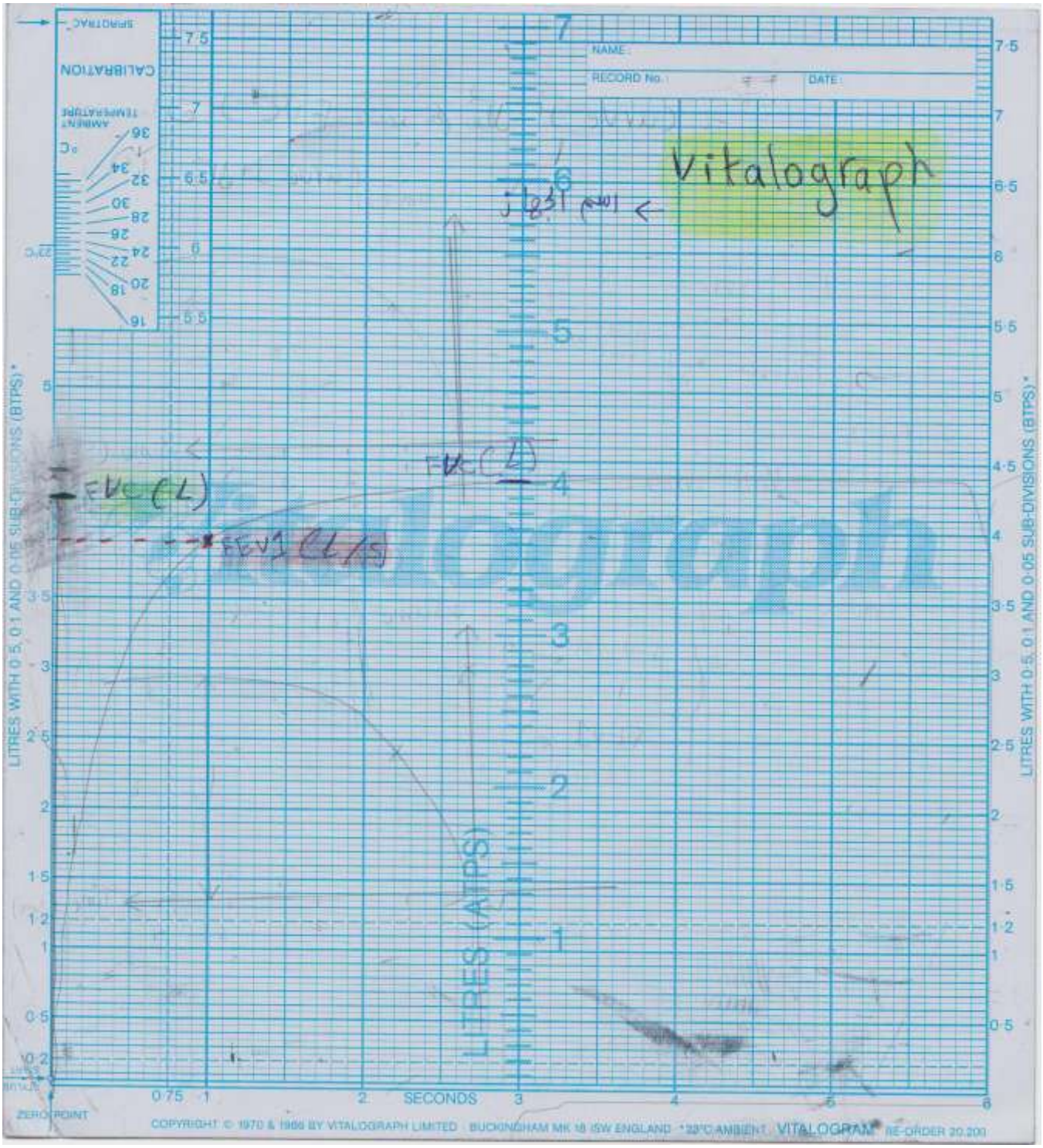
Vitalograph
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RECORD No.:
DATE:
CALIBRATION
SPIROTRAC
AMBIENT TEMPERATURE °C
FVC (L)
FEV1 (L/S)
PEF (L/S BTPS)
SECONDS
LITRES WITH 0·5, 0·1 AND 0·05 SUB-DIVISIONS (BTPS)*
ZERO POINT
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VITALOGRAM
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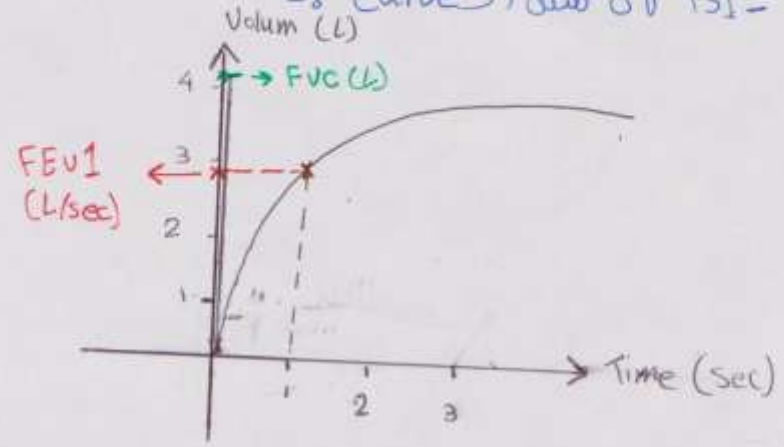
* حسابه الـ FVC يعتمد على شكل الـ Curve

- إذا كان شكل الـ Curve



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