In The Name Of God

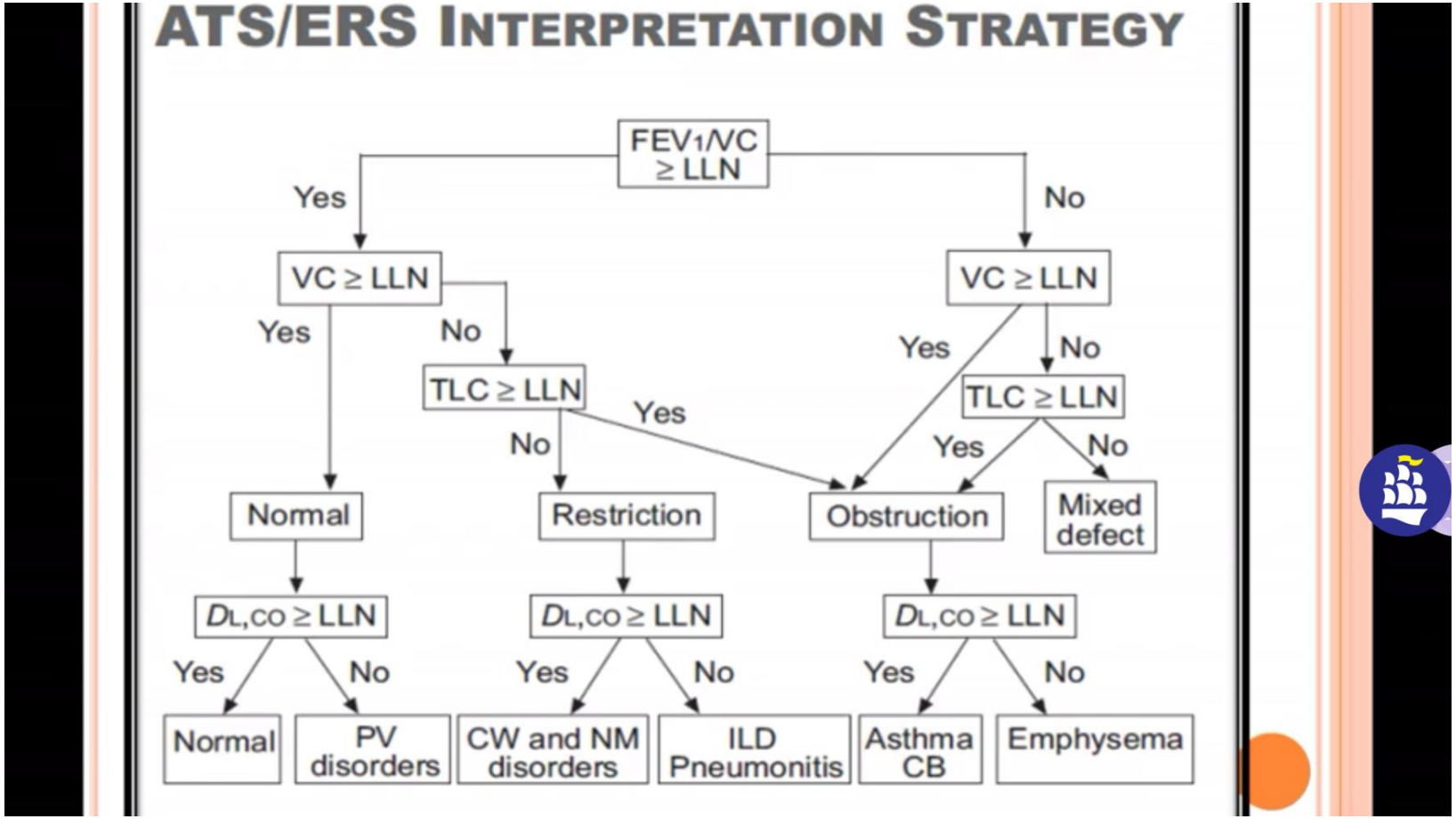
# Spirometry

# SPIROMETRY;PFT

Volume:FEV1,FVC,RV,IRV

CAPACITY:TLC,FRC,FVC,IC

# PFT INTERPRETATION



# Goals:

- volume air( ENTER&EXIT)
- rate air
- compliance lungs
- Membrane characteristic
- Response to treatment

# indications

- 1:Before surgery
- Age more than 65 yo
- Known case lung dx
- Obesity
- Prolong anesthesia
- Abdominal or thorax surgery
- 2:smokers
- 3:copd
- 4:asthma
- 5;AR
- 6:Interstitioal lung dx
- 7:exertional dyspnea
- 8:chest tightness
- 9:chronic cough
- 10:CAD( MOSTLY SMOKER)
- 11:NOROMASCULAR DX
- 12:OCUPATIONAL DX
- 13:CHRONIC PNEUMONIA
- 14:SYSTEMIC DX(RA.SLE….)

# Preparation:

- Dc SABA. 8 HR ;
- DC LABA &THEOPHYLINE 12 HR;
- DC CROMOLINE 24 HRS;DC ANTI HISTAMINE 24 HR;
- no CAFFEINE & exercise &cold exposure .SAMA since 6hr
- No usage CC blockers
- CONTINUE ICS &OCS

The patient must be clinically stable

- should sit straight, with head erect
- nose clip in place
- holding the mouthpiece tightly between the lips
- Initially, he or she should breathe in and out at the tidal volume *to record* the tidal flow–volume loop

# contraindications:

- MI RECENTLY or PTE
- Unknown hemoptysis
- Pneumothorax
- Aneurysem thorax.abdomen.brain
- Epilepsy
- URTI in 2 wks
- CVA  in 3WKS
- Eyes surgery
- Unstable angina

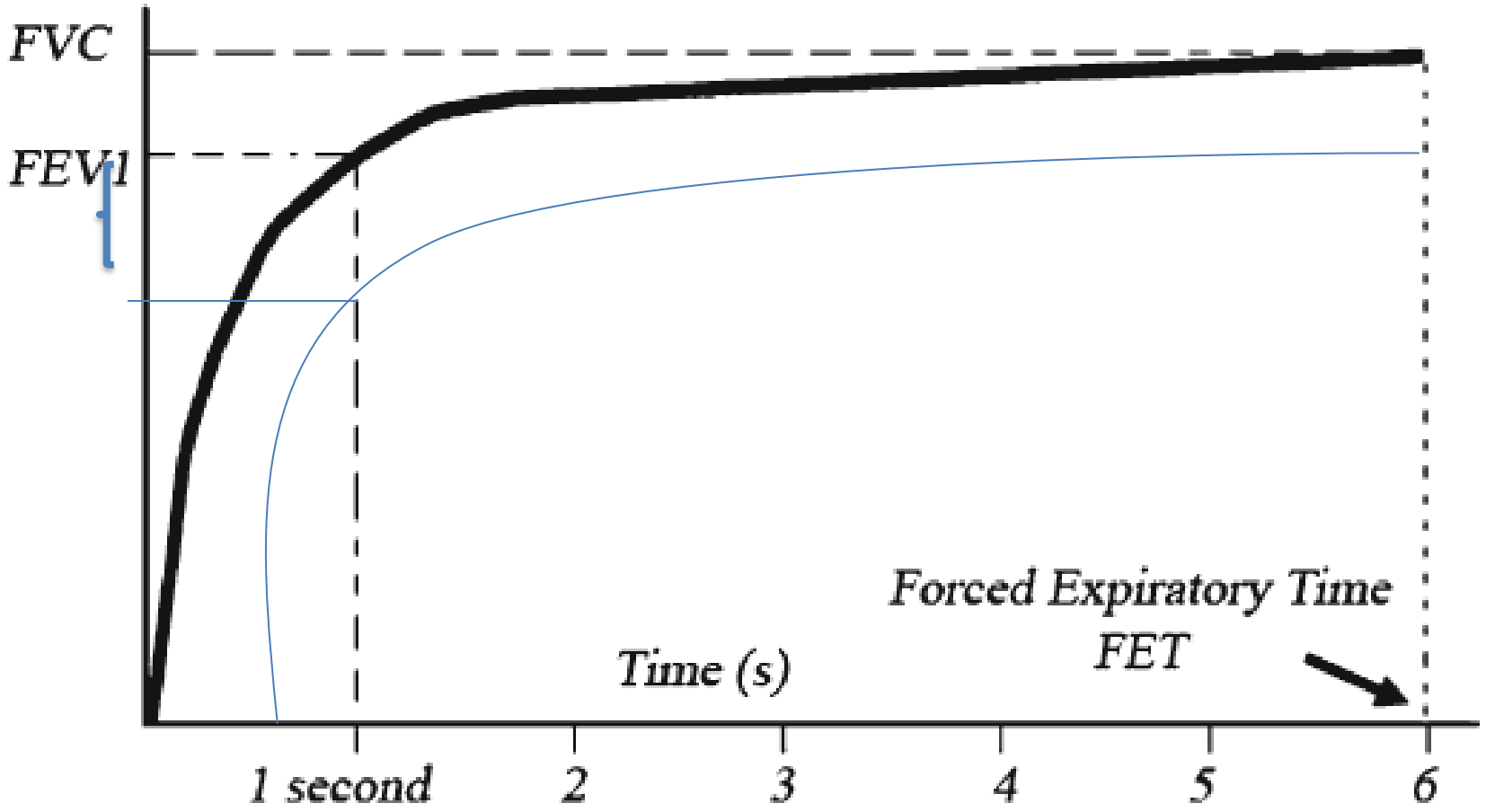
# Good technique

- No cough
- Good start(quickly and strongly no delay more than 120 ml sec)
- Between  min :3-6 sec  max15-20 sec…keep on keep on…
- No change in flow for 2sec (+ plateue)
- Flow rate fixed..in fvc
- Repeatidity effort( 5% or 100 ml  common  in 2 fvc or fev1 )

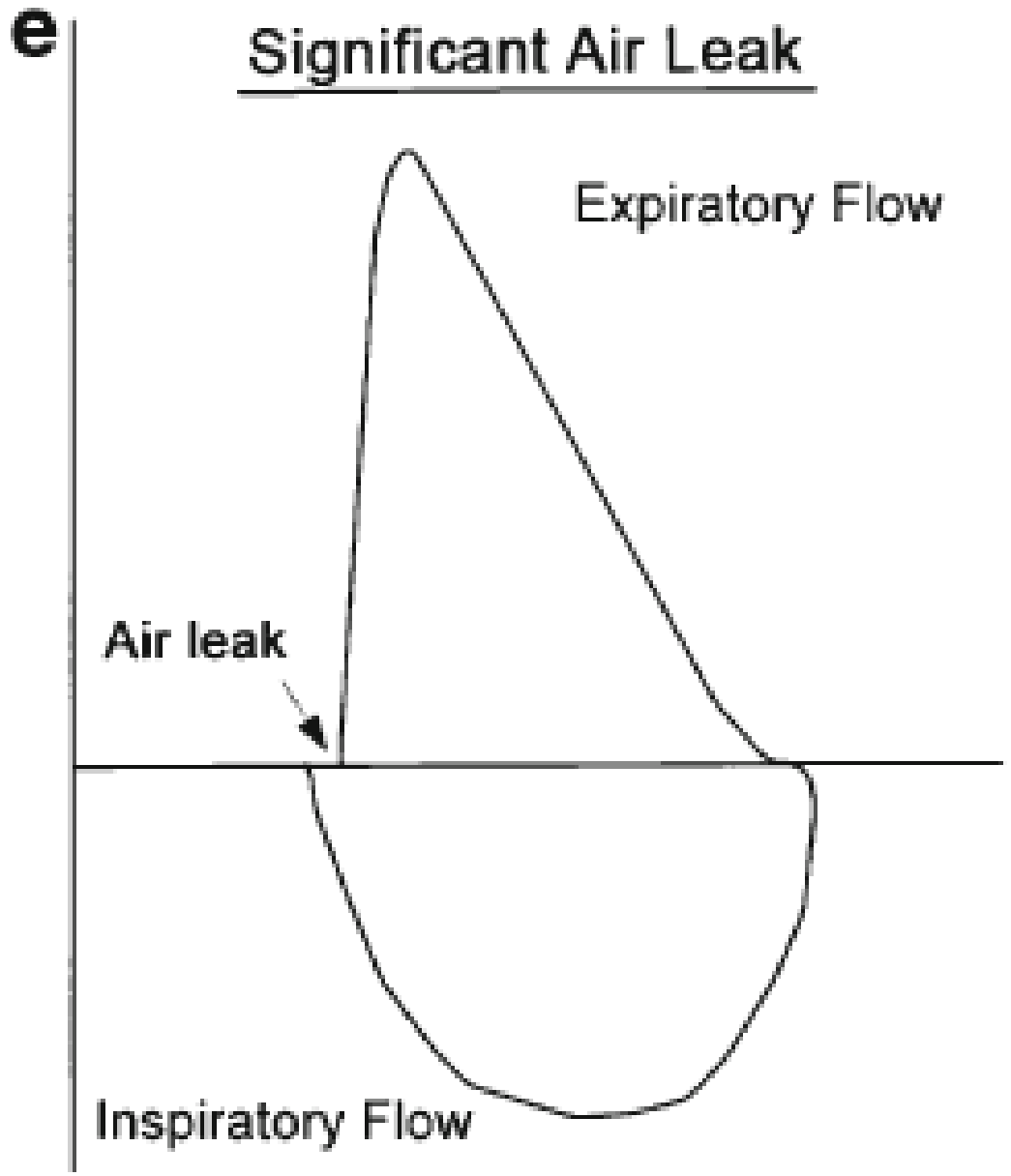
# Inclusion Criteria:

- max fvc difference with previous fvc less than150- 200cc
- Max fev1 ( less than150- 200 cc)
- 3-8 time min &max repeat

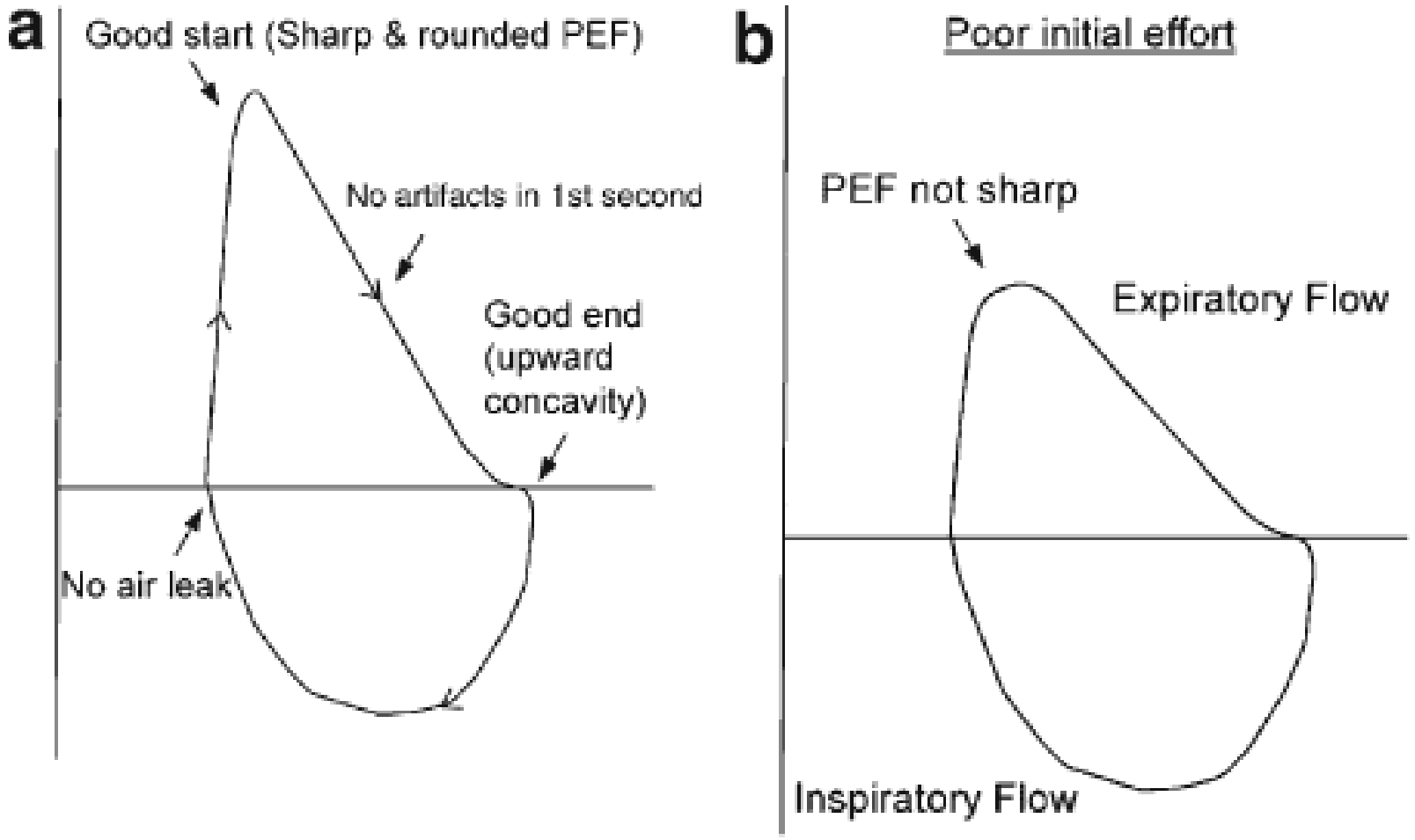
FVC&FE
V1



LEAK


e
Significant Air Leak
Expiratory Flow
Air leak
Inspiratory Flow

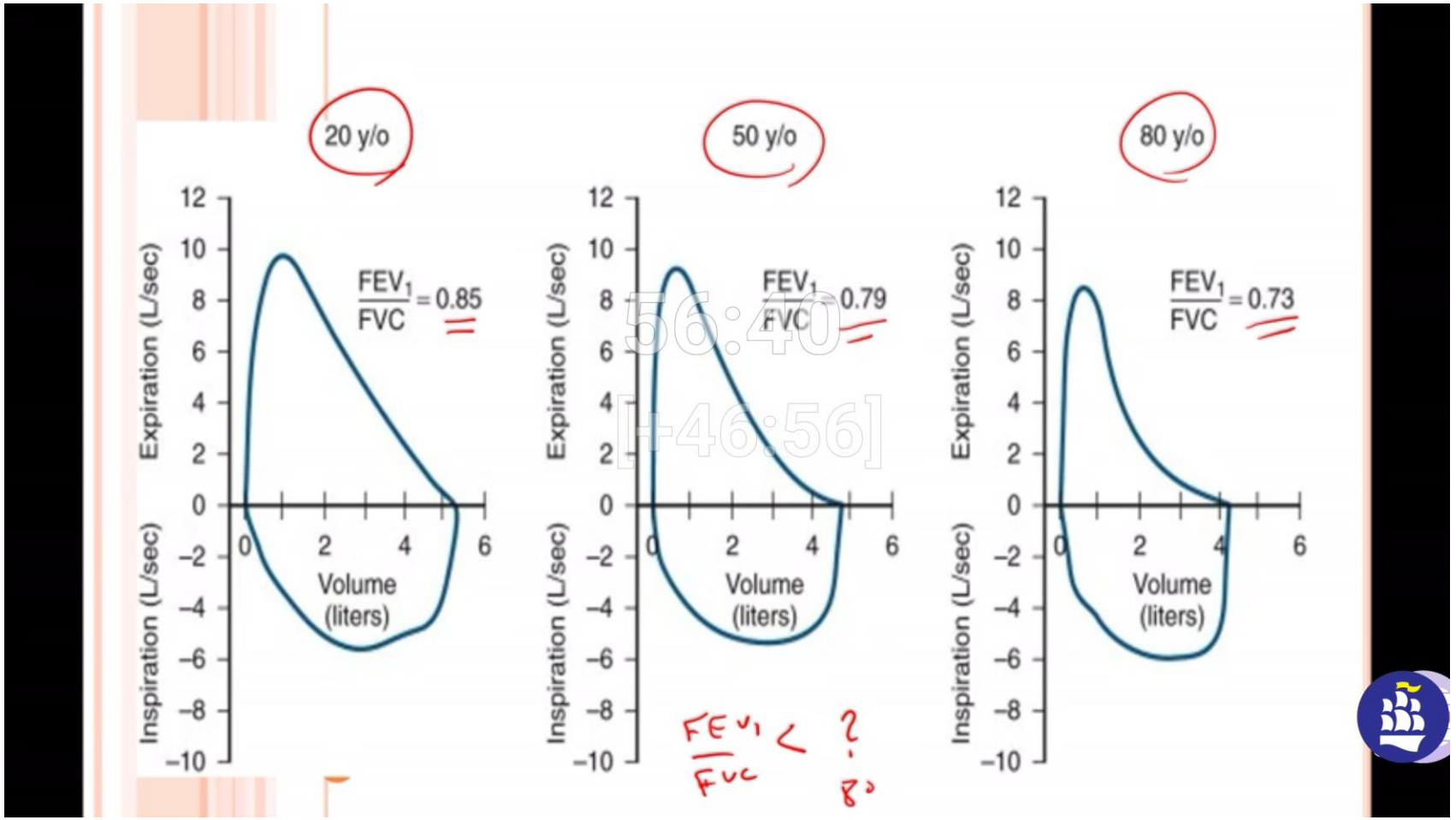
GOOD


a
Good start (Sharp & rounded PEF)
No artifacts in 1st second
Good end
(upward
concavity)
No air leak
b
Poor initial effort
PEF not sharp
Expiratory Flow
Inspiratory Flow

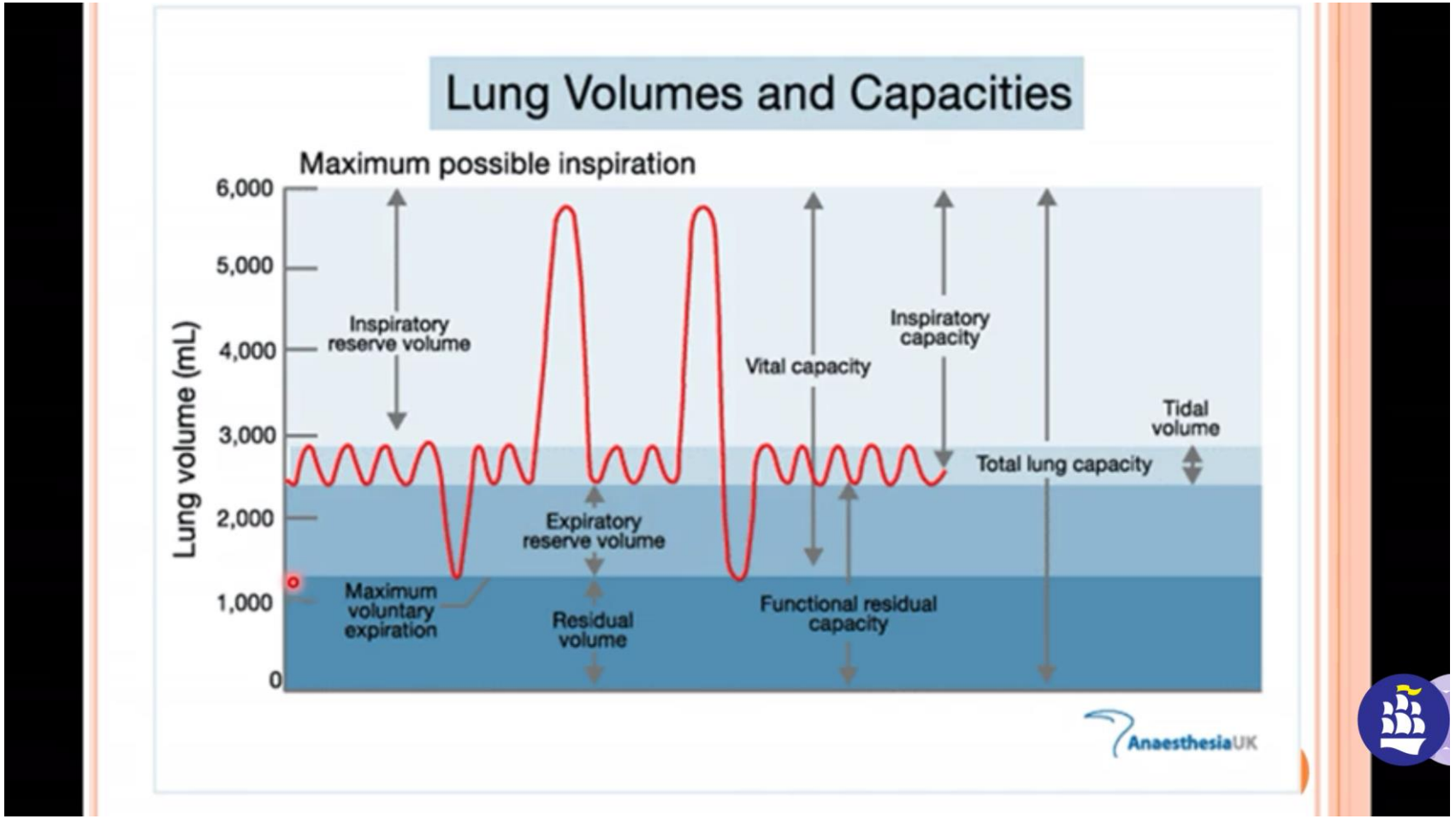
# REFERENCE VALUES

- – Sex (Men have bigger lungs than women.)
- – Age (The spirometric values drop with age.)
- – Height (Tall people have bigger lungs. If it is difficult to measure the height, as in kyphoscoliosis, then the arm span can be measured instead)
- race (Caucasians have bigger lungs than Africans and Asians)

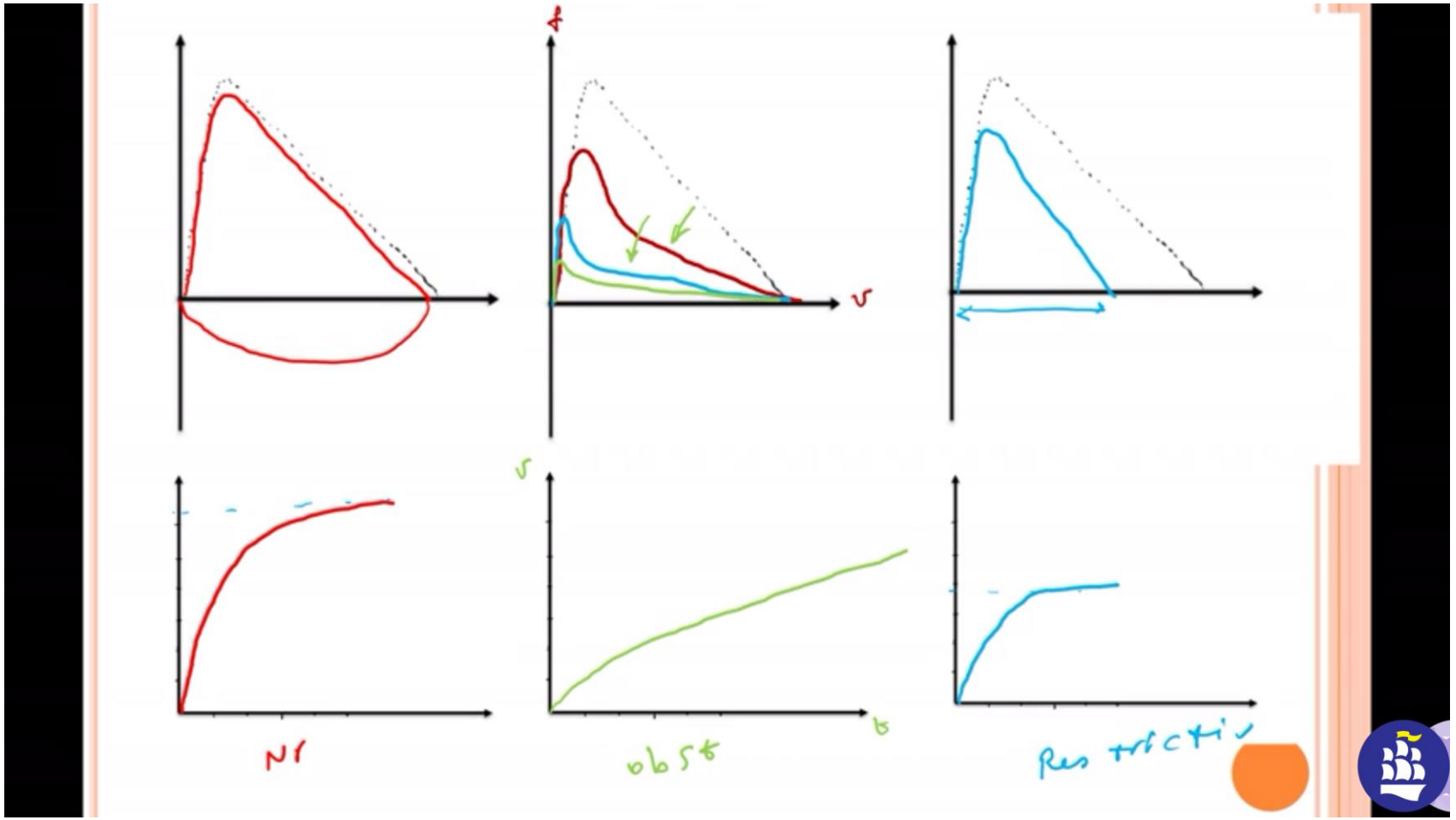
NL PFT


20 y/o
50 y/o
80 y/o
Expiration (L/sec)
Inspiration (L/sec)
Volume (liters)
FEV1/FVC = 0.85
FEV1/FVC = 0.79
FEV1/FVC = 0.73
12
10
8
6
4
2
0
−2
−4
−6
−8
−10
0
2
4
6

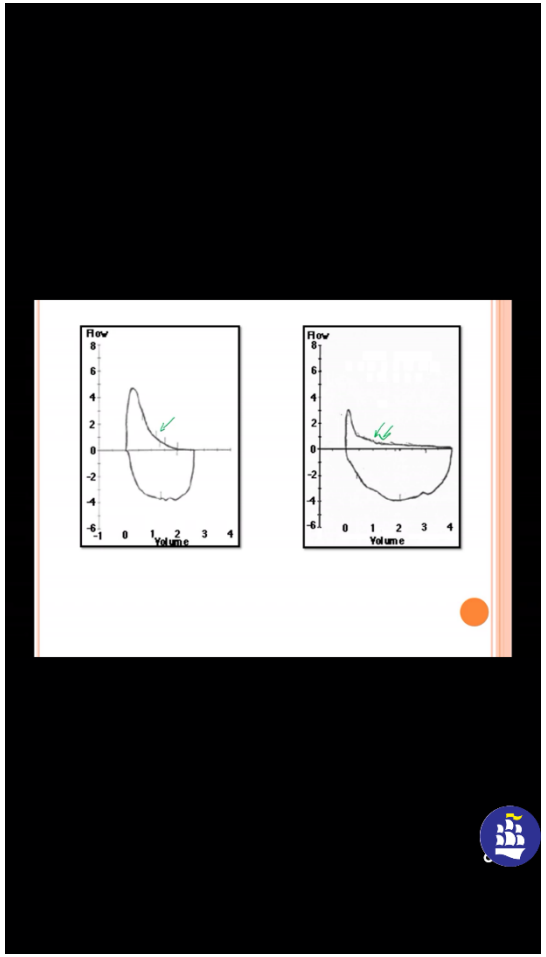
# VOLUME &CAPACITY



# OBS&RES DX



# MILD &SEVERE



# INTRA&EXTRA& FIXED OBS

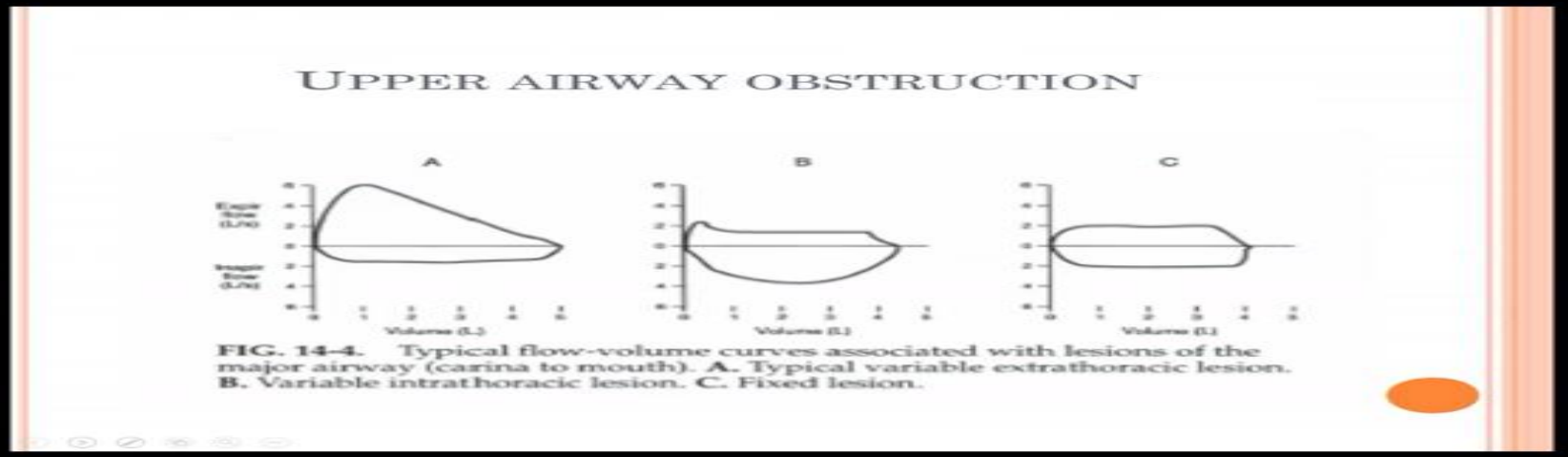
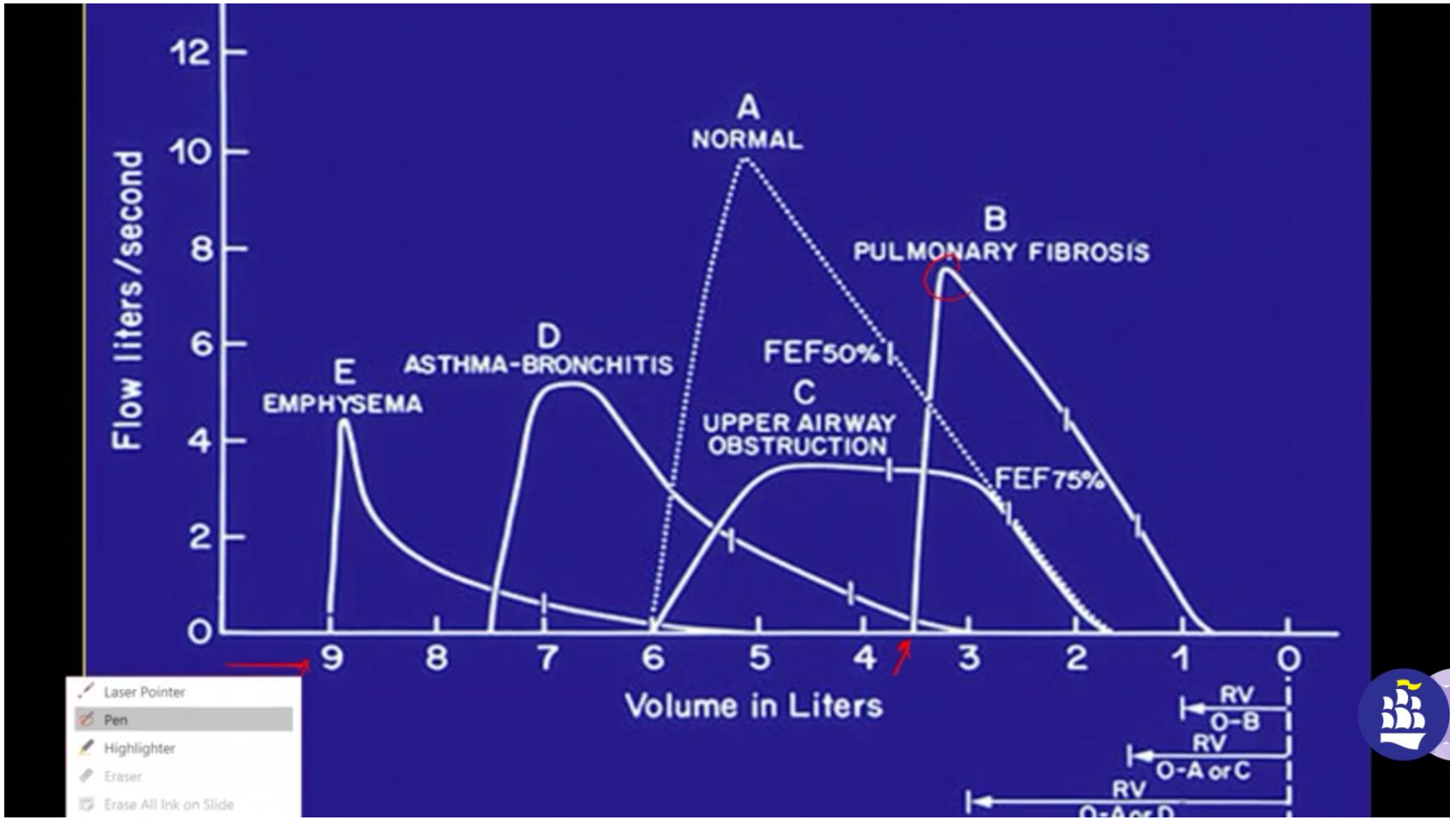
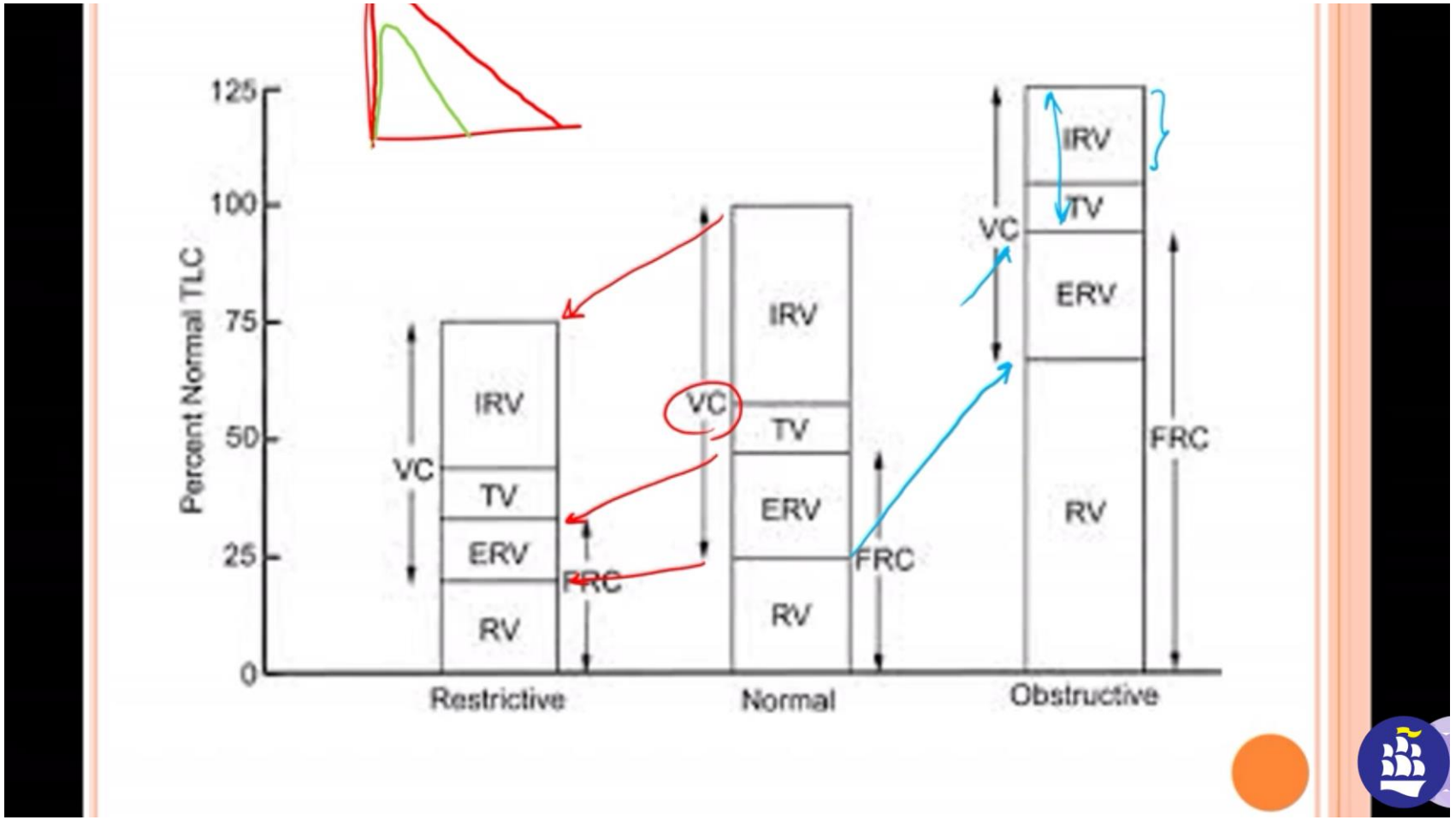



**FIG. 14-4.** Typical flow-volume curves associated with lesions of the major airway (carina to mouth). **A.** Typical variable extrathoracic lesion. **B.** Variable intrathoracic lesion. **C.** Fixed lesion.

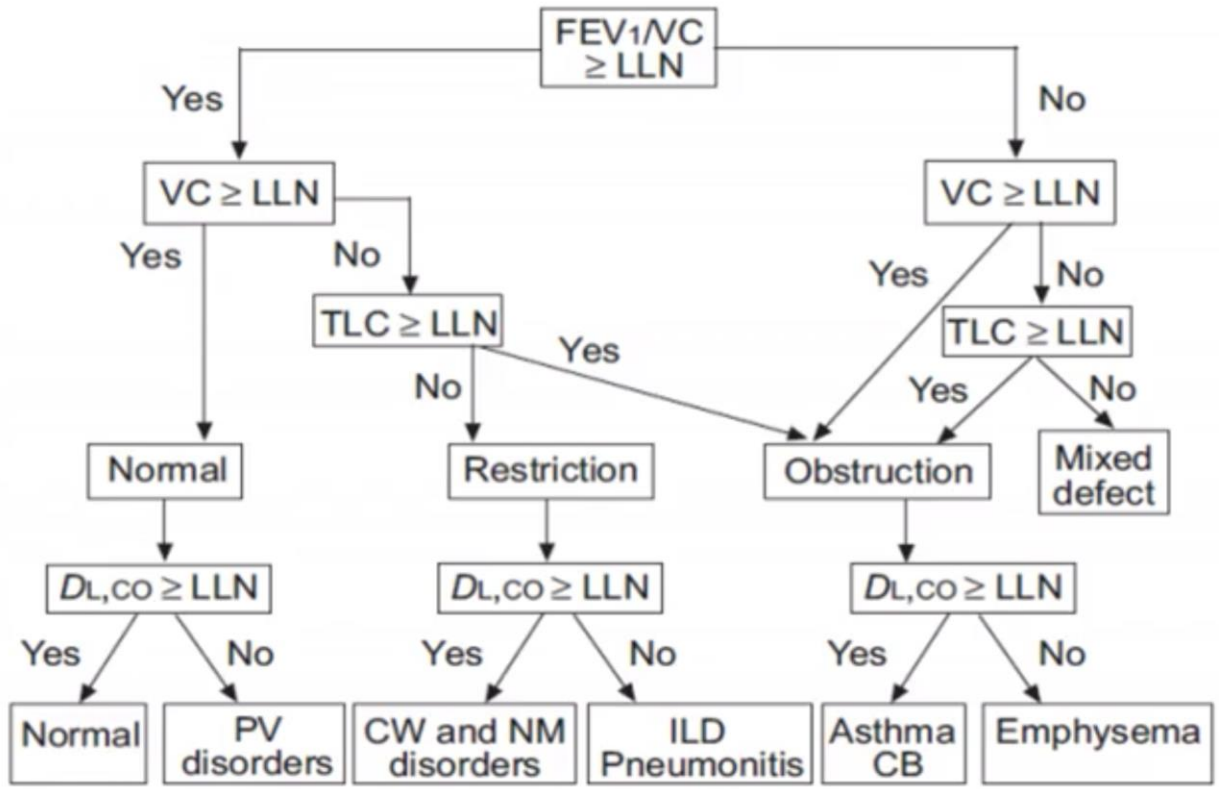
# CURVES


Flow liters/second
12
10
8
6
4
2
0
A
NORMAL
B
PULMONARY FIBROSIS
D
ASTHMA-BRONCHITIS
E
EMPHYSEMA
C
UPPER AIRWAY
OBSTRUCTION
FEF50%
FEF75%
9
8
7
6
5
4
3
2
1
0
Volume in Liters
RV
O-B
RV
O-A or C
RV
Laser Pointer
Pen
Highlighter
Eraser
Erase All Ink on Slide

# DIFFERENCE


125
100
75
50
25
0
Percent Normal TLC
IRV
TV
ERV
RV
VC
FRC
Restrictive
Normal
Obstructive

# ATS/ERS Interpretation Strategy



| **(A) Grading of severity of any spirometric abnormality based on $FEV_1$[10]** | |
|---|---|
| After determining the pattern to be obstructive, restrictive, or mixed, $FEV_1$ is used to grade severity: | |
| Mild | $FEV_1$ > 70 (% pred.) |
| Moderate | 60–69 |
| Moderately Severe | 50–59 |
| Severe | 35–49 |
| Very severe | <35 |

# GRADING OF SEVERITY

- In restrictive disorders, however, FEV1/FVC ratio is normal and the FVC is less than 80% predicted
- FVC may be used to make that grading.

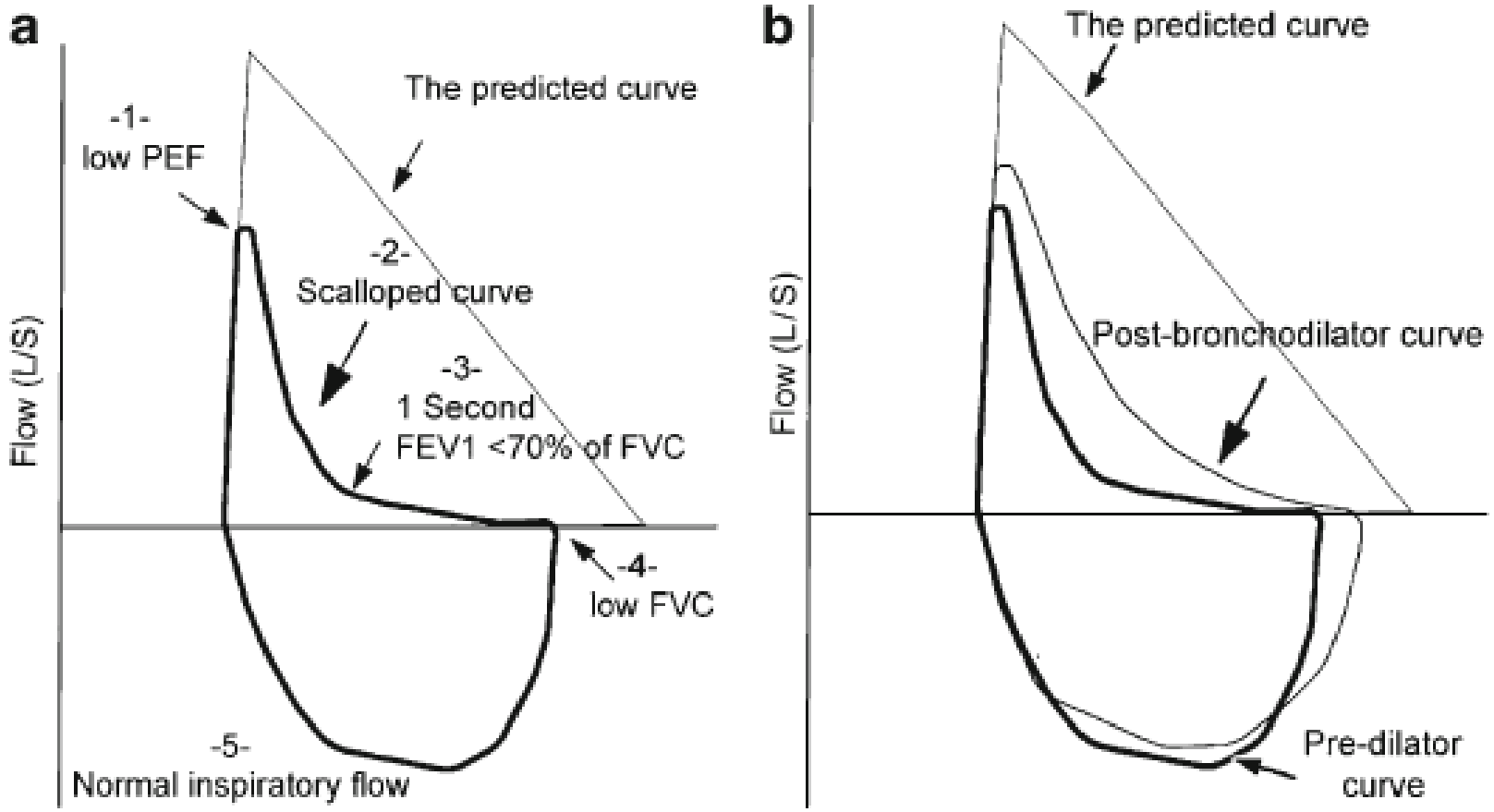
# RESTRICTIVE DX

| • Restrictive disorder (based on FVC, in case no lung volume study is available) | |
|---|---|
| Mild | FVC > 70 (% pred.) |
| Moderate | 60–69 |
| Moderately severe | 50–59 |
| Severe | 35–49 |
| Very severe | <35 |

# Features of obstructive disorders

- ↓ FEV 1 /FVC ratio
- Other features:
- ↓ FEV 1
- ↓ FVC (can be normal)
- ↓ FEFs and MMEF (FEF 25 , FEF 50, FEF 75 , FEF 25–75 )
- ↓ PEF
- ↓ FET
- Significant bronchodilator response
- Scooped (concave) descending limb of FV curve

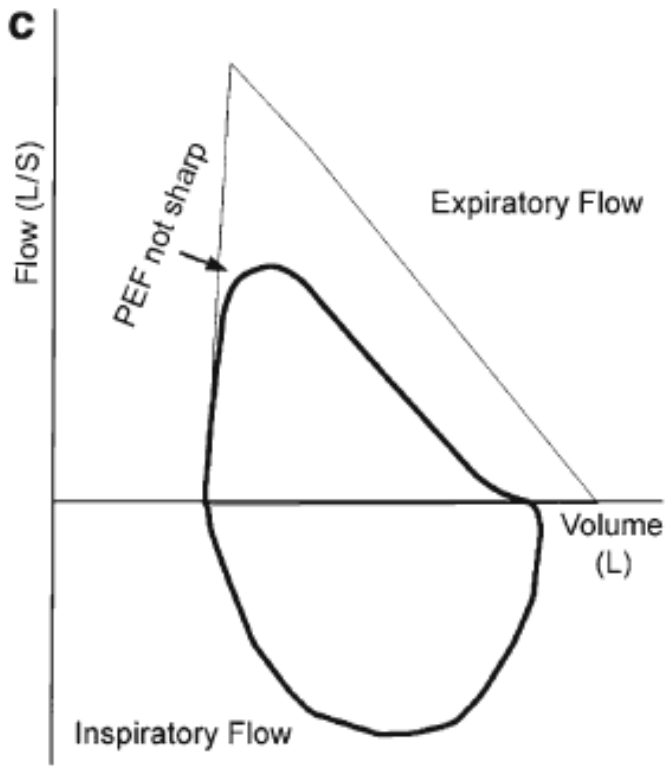
# OBSTRUCTIVE DX



# Features of restrictive disorders

- Most important features: ↓ FVC and normal or ↑ FEV 1 /FVC ratio
- Other features:
- ↓ FEV 1 (proportional to FVC), but it can be normal
- PEF: normal, increased, or decreased

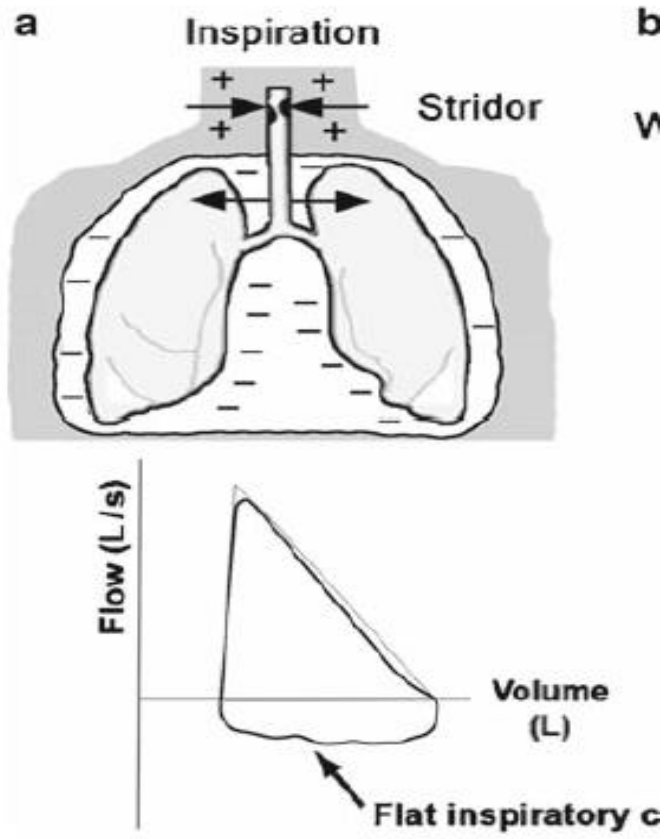
# poor effort study



# Causes of restrictive disorders

- Parenchymal :pulmonary fibrosis and other interstitial lung diseases (ILD)
- Pleural disease as pleural fibrosis (uncommon)
- Chest wall restriction:
- Musculoskeletal disorders (MSD), e.g. severe kyphoscoliosis
- Neuromuscular disorders (NMD), e.g. muscular dystrophy, amyotrophic
- lateral sclerosis (ALS), old poliomyelitis, paralyzed diaphragm;
- Diaphragmatic distention (pregnancy, ascites, obesity)
- Obesity (restricting chest wall movement)
- Loss of air spaces:
- Resection (lobectomy, pneumonectomy)
- Atelectasis
- Tumors (filling or compressing alveolar spaces)
- Pulmonary edema
- Pleural cavity disease (pleural effusion, extensive cardiomegaly, large
- pleural tumor)

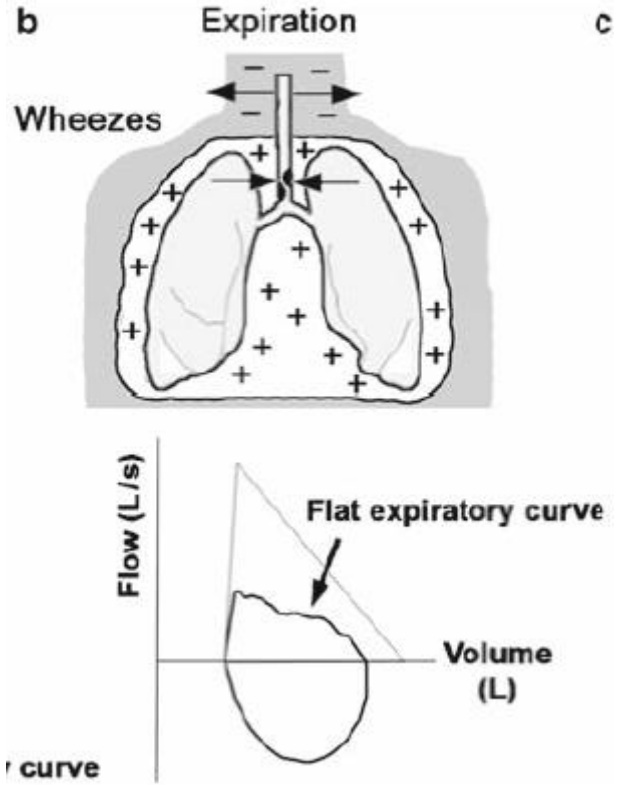
# variable extrathoracic obstruction



# Variable extrathoracic lesions (lesions above the sternal notch)

- Dynamic tumors of hypopharynx or upper trachea
- Vocal cord paralysis
- Dynamic subglottic stenosis
- External compression of upper trachea (e.g., by goiter)

# Variable intrathoracic obstruction



# Variable intrathoracic lesions (lesions below the sternal notch)

- Dynamic tumors of the lower trachea
- Tracheomalacia
- Dynamic tracheal strictures
- Chronic inflammatory disorders of the upper airways (e.g., Wegener
- granulomatosis, relapsing polychondritis)
- External compression of lower trachea (e.g., by retrosternal goiter)

# Fixed lesions (lesions at any level in the major airways)

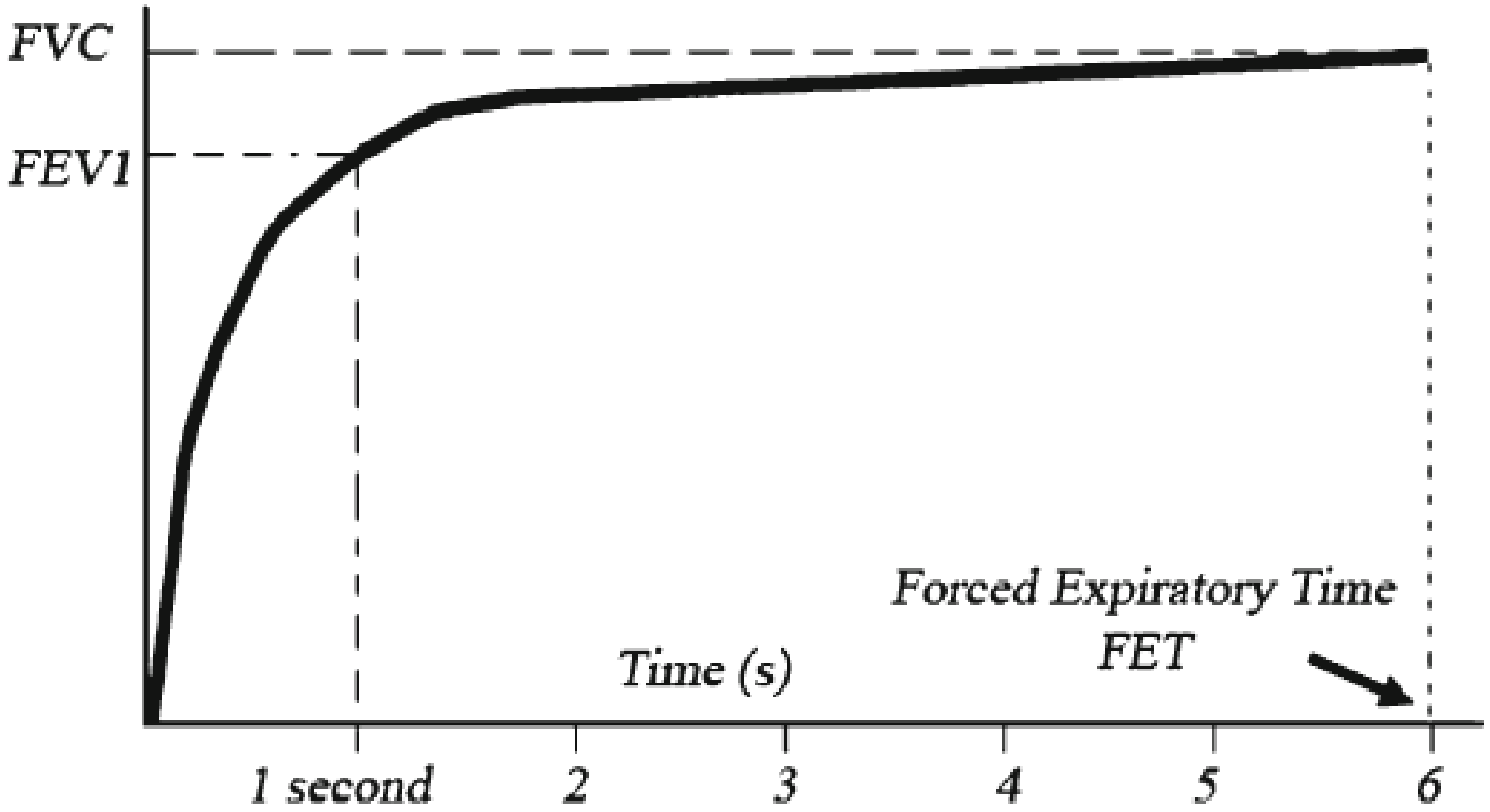
- Non-dynamic tumors at any level of upper airways
- Fibrotic stricture of upper airways

# The *slow vital capacity (SVC)*

- *– also called the vital capacity*
- *(VC) – is similar to the FVC, but the exhalation is slow rather*
- than being as rapid as possible as in the FVC.
- In a normal subject, the SVC usually equals the FVC
- while in patients with an obstructive lung disorder SVC is usually larger than the FVC
-

# REASONS:

- The reason for this is that, in obstructive lung disorders, the airways tend to collapse and
- close prematurely because of the increased positive intrathoracic pressure during a forceful expiration
- This increased pressure leads to air trapping
- Accordingly, a significantly higher SVC compared with FVC suggests air-trapping;


FVC
FEV1
Forced Expiratory Time
FET
Time (s)
1 second
2
3
4
5
6

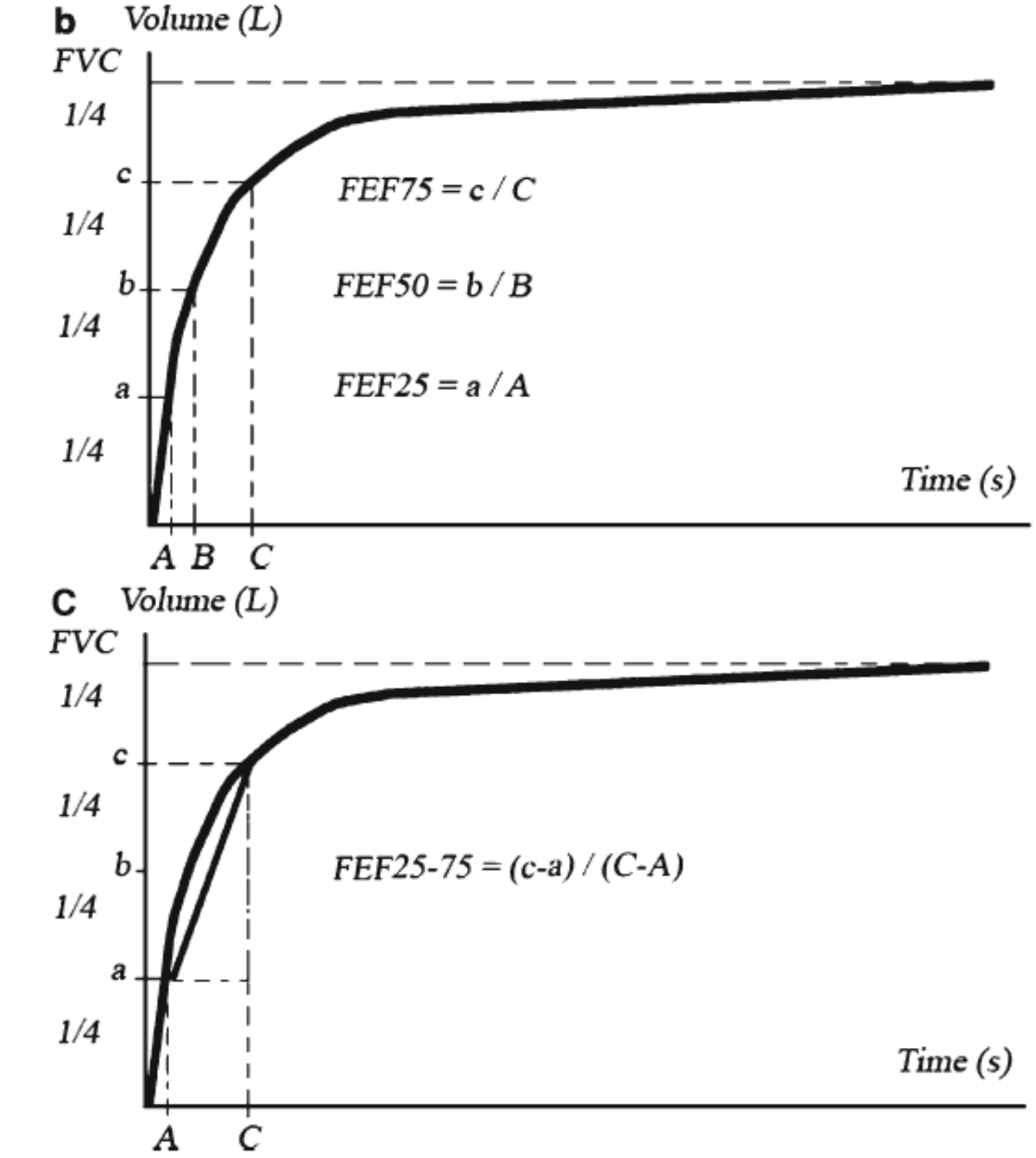
# FEV 1 /FVC Ratio

- In obstructive disorders,
- FEV 1 drops much more significantly than FVC and the ratio will be low
- while in restrictive disorders, the ratio is either
- normal or even increased as the drop in FVC is either proportional to or more marked than the drop in FEV 1

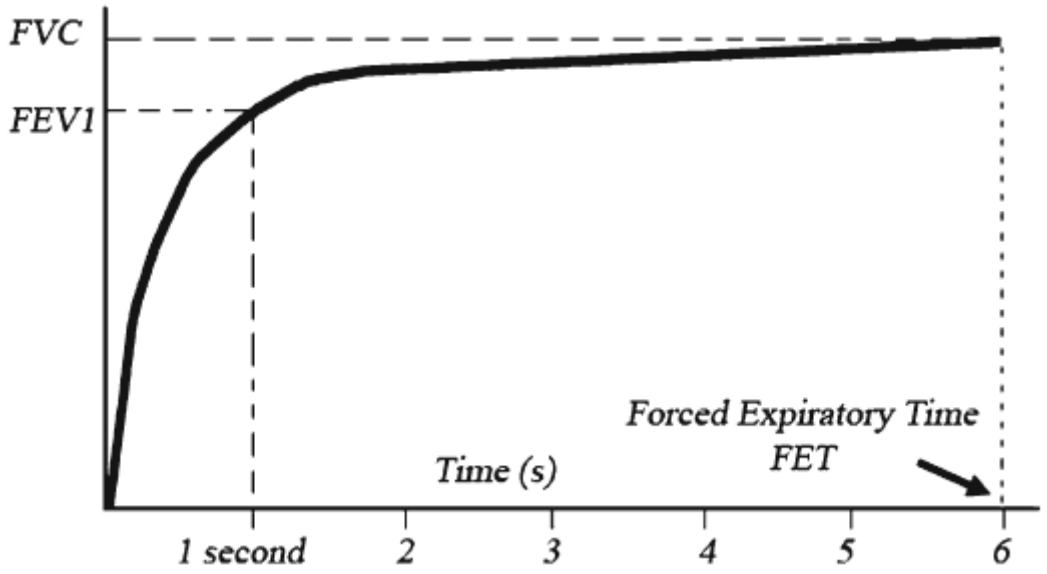
- Normally, the FEV 1 /FVC ratio is greater than 0.7 (some references≥0.8)
- but it decreases (to values <0.7) with normal aging
- In children, however, it is higher and can reach as high as 0.9
- The changes in the elderly probably reflect the decrease in elastic recoil of the lungs that occurs with aging.

# (FEF 25 , FEF 50 , FEF 75 ) and the Maximum Mid-Expiratory Flow (MMEF or FEF 25–75 )

- represents the flow of the exhaled air measured (in liters per second) at different points of the FVC, namely at 25, 50, and 75% of the FVC
- The maximum mid-expiratory flow (MMEF) or
- *FEF 25–75 , however, is the average flow during the middle half* of the FVC (25–75% of FVC);

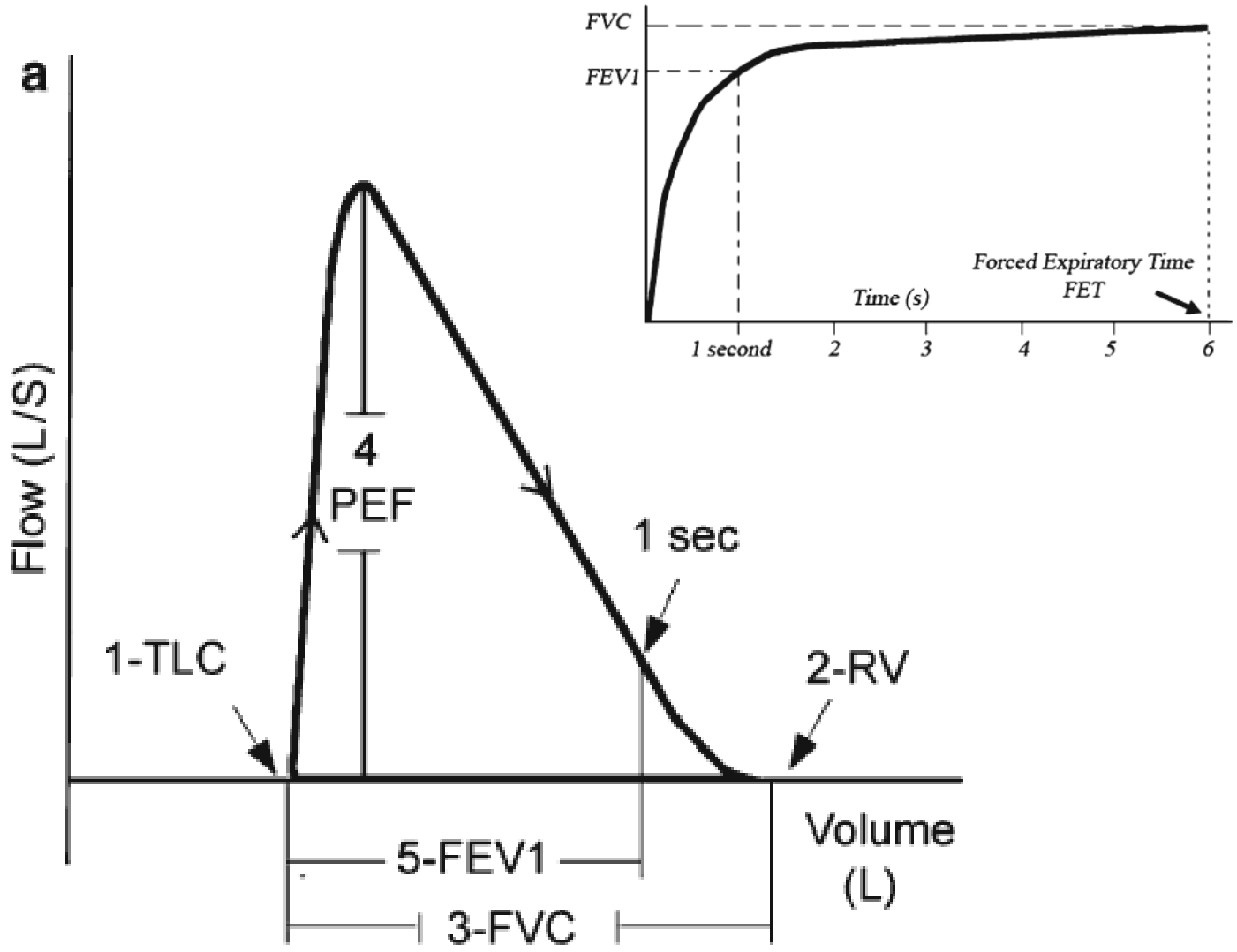

b
Volume (L)
FVC
1/4
c
1/4
b
1/4
a
1/4
FEF75 = c / C
FEF50 = b / B
FEF25 = a / A
Time (s)
A
B
C
C
Volume (L)
FVC
1/4
c
1/4
b
1/4
a
1/4
FEF25-75 = (c-a) / (C-A)
Time (s)
A
C

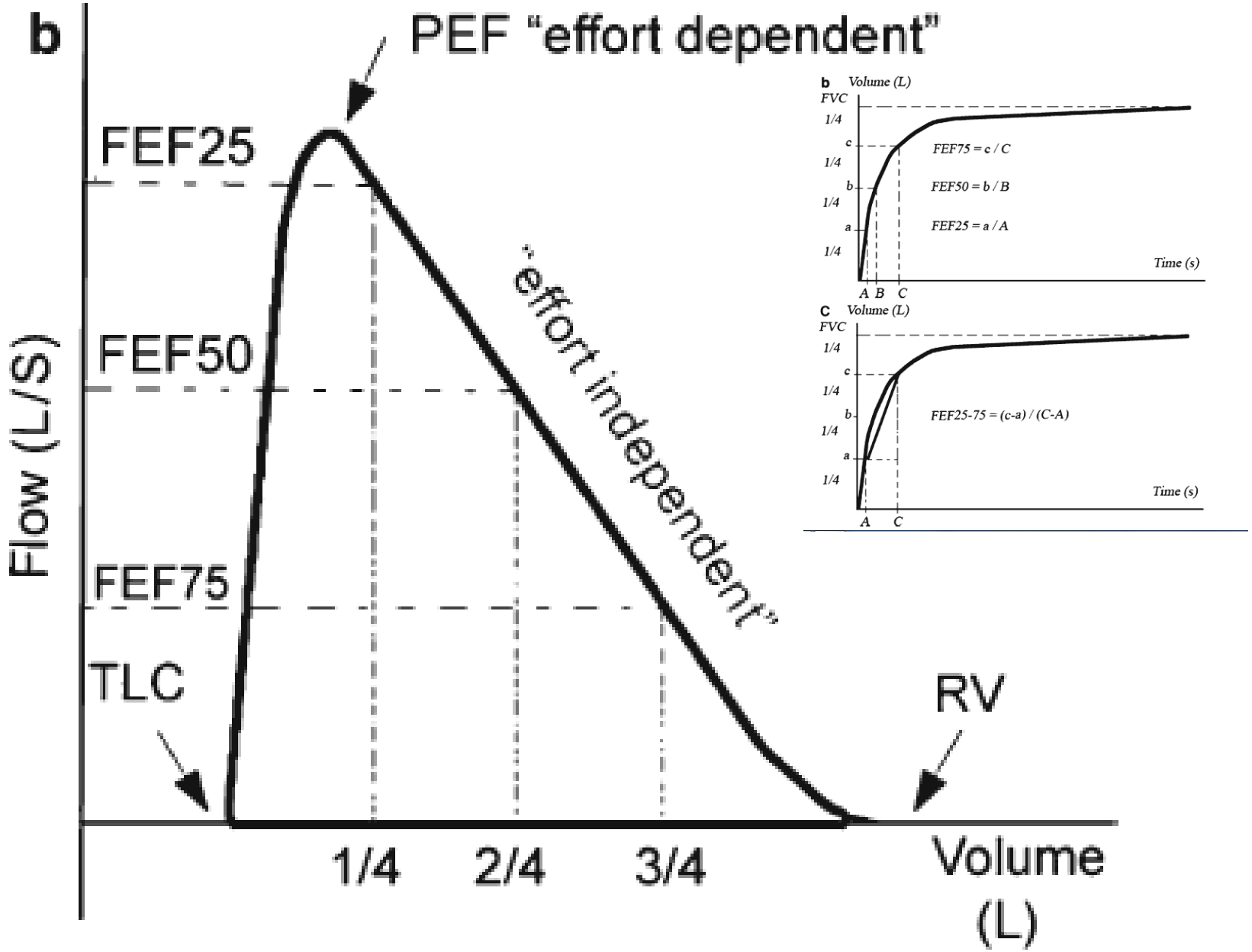
# The Volume–Time Curve

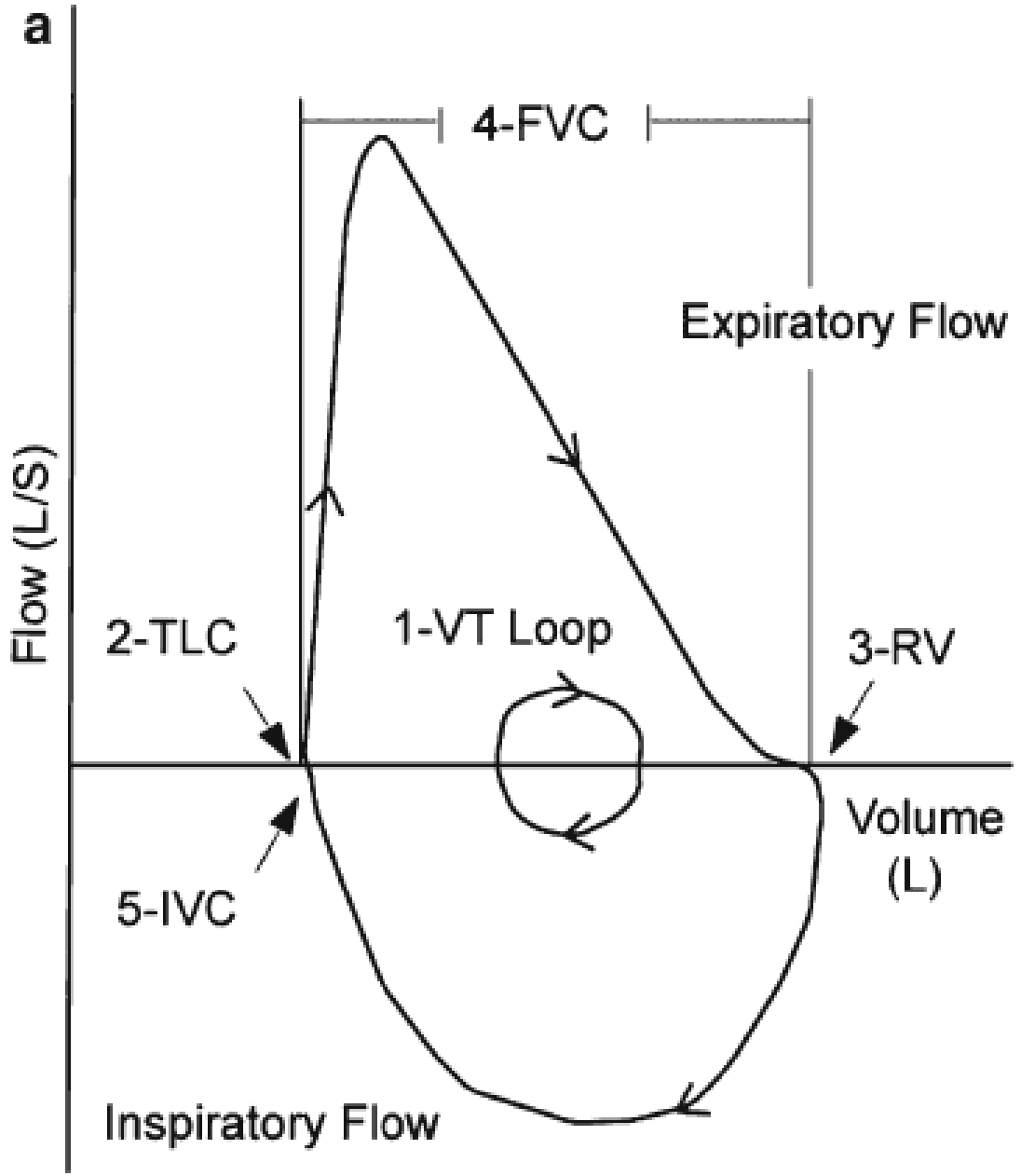



Is simply the FVC plotted as volume in liters against time in seconds

# F/V


a
Flow (L/S)
4
PEF
1 sec
1-TLC
2-RV
5-FEV1
3-FVC
Volume
(L)
FVC
FEV1
Time (s)
Forced Expiratory Time
FET
1 second
2
3
4
5
6


b
PEF "effort dependent"
FEF25
FEF50
FEF75
TLC
RV
"effort independent"
Flow (L/S)
1/4
2/4
3/4
Volume
(L)
b Volume (L)
FVC
1/4
c
1/4
b
1/4
a
1/4
FEF75 = c / C
FEF50 = b / B
FEF25 = a / A
Time (s)
A B C
C Volume (L)
FVC
1/4
c
1/4
b
1/4
a
1/4
FEF25-75 = (c-a) / (C-A)
Time (s)
A C


a
4-FVC
Expiratory Flow
Flow (L/S)
2-TLC
1-VT Loop
3-RV
Volume
(L)
5-IVC
Inspiratory Flow

- Thank you for your attention

- Dr.M.Ahoon Allergist&Immunologist