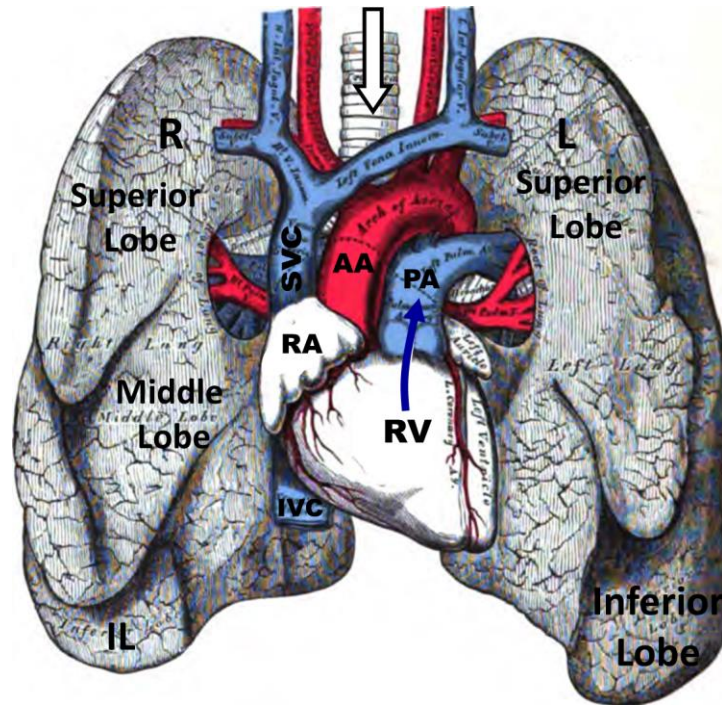# Lecture 44
APPLICATIONS

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A 72-year-old female visits her pulmonologist complaining about some shortness of breath especially when she attempts to walk up even one flight of stairs. After a full examination, she was scheduled for an initial test procedure in which her resting cardiac output (CO) was determined via echocardiography to be 3.0 liters/min. Right after the echo arterial and venous blood samples were drawn that showed her arterial and venous oxygen concentrations to be 10 and 7 ml of O_2 per 100 ml of blood. Based on these test results what is the value of her oxygen utilization expressed in units of mlO2/min?

A.   100
B.   120
C.   140
D.   160
E.   180

An 82-year-old man who weighs 200 pounds which is normal for his height recently developed a breathing problem. His pulmonologist speculates that this may be due to an increase in his physiological dead space (PDS). To test this idea his pulmonologist ordered a test procedure aimed at evaluating his PDS. Prior to the PDS test, a standard spirogram is done that shows his resting tidal volume to be 700 ml and his respiration rate to be 16 breaths/min. For the PDS test, arterial blood is drawn which shows his arterial CO_2 pressure to be elevated at 55 mmHg. Finally, he breathes into a collecting bag that shows that the CO_2 pressure in his expired air is 35 mmHg. Based on these tests which of the following is closest to his calculated PDS expressed in ml?

A.   150
B.   250
C.   300
D.   350
E.   400

A patient in a Ft. Lauderdale hospital who has a severe case of COVID-19 is placed on a ventilator that is adjusted to have a tidal volume of 600 ml at a rate of 20 per minute. The ventilator has a dead space of 250 ml and the patient's anatomical dead space is 150 ml. Through an auxiliary connection to the ventilator, 40% oxygen is supplied so that the patient is breathing in 40% O2. It is estimated that based on the patient's diet his respiratory quotient is 0.85. The attending pulmonologist determines that the patient's alveolar carbon dioxide tension is abnormally high at 65 mmHg. The calculated alveolar oxygen tension of this patient, based on the data needed to calculate it, is closest to which one of the following expressed in mmHg?

A. 100
B. 200
C. 300
D. 400
E. 600

A 75-year-old female who weighs 320 pounds has a tidal volume (TV) of 700 ml and a respiratory rate of 12 breaths per minute. It is estimated that her anatomical dead space is 300 ml. His calculated alveolar ventilation in liters/minute is closest to which one of the following?

A.   3
B.   4
C.   5
D.   6
E.   7

A 47-year-old female takes a helium dilution test using a 6000 ml spirometer. The starting helium concentration is 25%. She starts breathing from the spirometer when her lung volume is equal to her functional residual capacity (FRC). At the end of the test, the helium concentration was 20%. What is the value of her FRC in ml?

A.   1200
B.   1500
C.   1800
D.   2100
E.   2400

A 78-year-old male recently experienced some difficulties in breathing. A comparison of his respiratory system volume-pressure curves obtained at age 28 and now at age 68 is shown in the figure below. Based on the data in the figure which of the following decreased at age 68 compared to age 28?

A.   functional reserve capacity (FRC)
B.   small airway resistance
C.   large airway resistance
D.   pulmonary blood flow
E.   pulmonary artery blood pressure

A 50-year-old male recently gave up smoking cigarettes but was concerned about his lung status. His physician suggested he undergo a certain test the results of which are shown in the figure below. Based on the features indicated in the figure, which point is at a position at which airflow depends only on recoil pressure?

A.   A
B.   B
C.   C
D.   D
E.   E

A 40-year-old female researcher has been working with irritating chemicals. She states that she has been experiencing an increase in her respiratory rate. Measurements indicate that her alveolar ventilation is 5000 ml/min and her whole-body CO_2 production is 300 ml/min. Use the alveolar ventilation equation with a K value of 0.863 to determine which of the following values is closest to her alveolar CO_2 tension in mmHg.

A.   35
B.   40
C.   45
D.   50
E.   55

Twenty years ago, a 58-year-old female had a lung scan that showed that her overall lung ventilation-perfusion ratio (V/Q) was normal with a value of 0.82.

Yesterday a repeat scan revealed her overall lung V/Q was 0.68. Based on this data, which one of the following is most likely true now compared to 20 years ago assuming no compensatory controls have intervened?

A.   Her alveolar ventilation has increased
B.   Her pulmonary blood flow has decreased
C.   Her systemic arterial PO2 will tend to be increased
D.   She has an increased tendency toward hypoxemia
E.   She has an increased tendency toward respiratory acidosis

10 Relationships (Equations= Concepts)

$$CO = \frac{\dot{V}O_2}{Ca_{O2} - Cv_{O2}}$$

$$V'_A = (TV - ADS) \times RR$$

$$PA_{CO2} = K \frac{CO_2 \text{ Production}}{\text{Alveolar Ventilation}} = K \frac{\dot{V}CO_2}{Q_A}$$

$$\text{Filtration pressure} = (P_c - P_i) - \sigma(\pi_c - \pi_i)$$

$$PA_{O2} = (P_{ATM} - 47) \times F_{IO2} - PA_{CO2}/R$$

$$1/C_{RS} = 1/C_L + 1/C_W$$

$$PDS = TV \times (1 - [P_E CO_2/P_a CO_2])$$

$$\phi = D (A/\delta) \Delta P$$

$$[O_2] = 1.34 \text{ mlO}_2/\text{gHb} \times [Hb] (\%Sat/100) + 0.003 PO_2$$

$$D_L = \frac{\phi_{O2}}{PA_{O2} - Pa_{O2}}$$

Transmural Pressures

P_{ATM}

Airway (P_{AW})

Intrathoracic P_{TH}

Alveolus

P_{ALV}

P_{REC}

Intrapleural (P_{IPL})

?

?

?
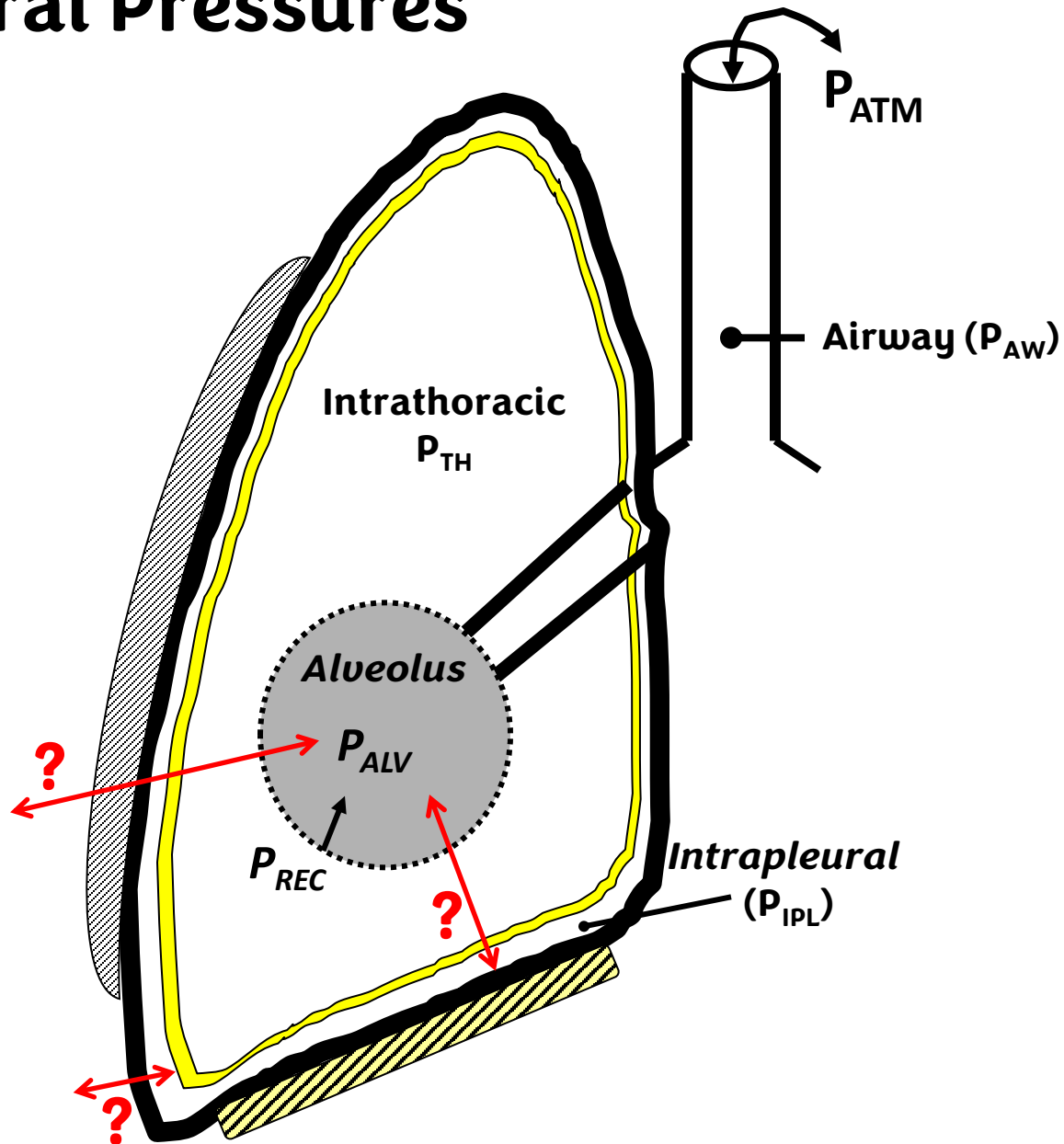
Questions as time permits