



Esophageal Balloon

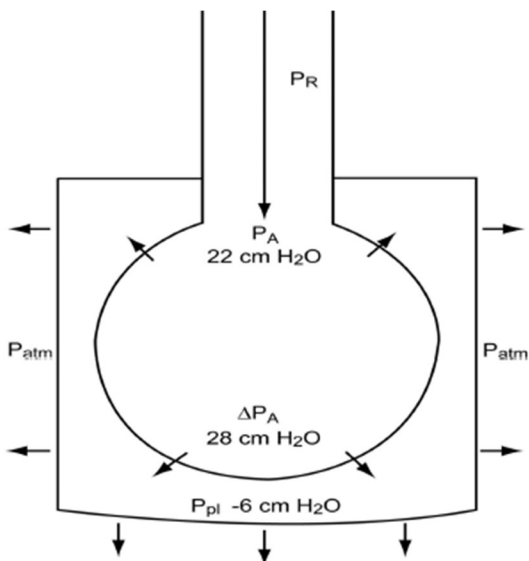
1) A

The esophageal pressures measured at the lower 1/3 of the esophagus are not exactly equal but used as a surrogate for the pleural pressure.

2) B

Trans-pulmonary pressure is the distending pressure across the alveoli and represented as the plateau (alveolar) pressure – the esophageal (pleural) pressure.

In the figure below: Alveolar Pressure (PA) 22 – Pleural pressure (PPL) -6 results in trans-pulmonary pressure of 28 cmH₂O.



3) B

B curve shows artifacts of the heart beats (which corresponds to good position of the catheter), and upward deflection in the pressures corresponding to the positive increase of pressure in the airways (black figure on the top). A doesn't show much heart artifacts and the deflections don't correspond to the airway pressure, and C don't show any heart beats. The position of the catheter needs to be evaluated with occlusion test to see the correlation of the deflection of the esophageal and airway pressures during occlusion maneuver.

4) A

The figure shows end expiratory trans-pulmonary pressures $-4 \text{ cmH}_2\text{O}$ (an end expiratory pause maneuver for couple seconds need to be done). PEEP need to be increased to have $0 - 2$ trans-pulmonary pressure to avoid the repeated closure and opening of the alveoli that might contribute to VILI.

5) B

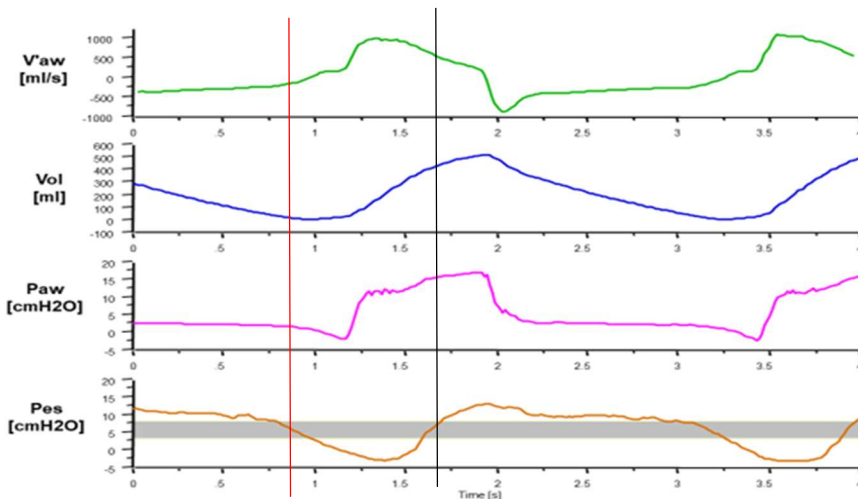
The inspiratory trans-pulmonary pressure is about $18 \text{ cmH}_2\text{O}$ which is too high and might also cause VILI, goal to keep it below $10 \text{ cmH}_2\text{O}$. Can achieve that by reducing the plateau pressure or driving pressure.

6) B

Figure A show very low hysteresis between the inspiratory and expiratory limb and no inflection points pointing to a non recruitable lung, figure B show a significant hysteresis and inflection points suggestive of a recruitable lung.

7) B

The curves show delayed trigger (red line) as esophageal pressure drops then time lag till the ventilator gives the breath secondary to intrinsic PEEP, also delayed cycling (black line) as the esophageal pressure went to baseline indicating muscles relaxation, but the ventilator is still giving breath.



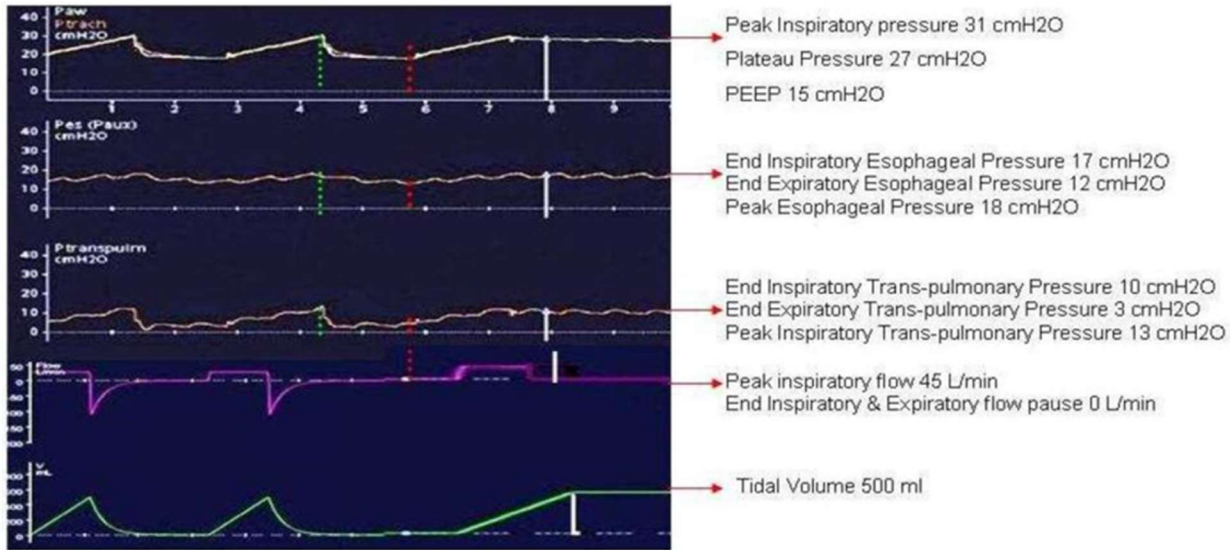
8) A

The red arrows represent missed efforts, the esophageal pressure drops corresponding to increase in airway flow but no breath is triggered after. This is also secondary to intrinsic PEEP as evidenced by expiratory flow not returning to zero before the subsequent breath.

9) C

The airway pressure – volume curve represents the whole respiratory system compliance, the esophageal pressure – volume curve represents the chest wall compliance, and the trans-pulmonary – volume curve represent the lung compliance.

10) C



Total respiratory compliance = $VT / P_{aw} - PEEP = 500 / 27 - 15 = 41.6 \text{ ml/cmH}_2\text{O}$

Chest wall compliance = $VT / \text{End inspiratory } P_{es} - \text{End expiratory } P_{es} = 500 / 17 - 12 = 100 \text{ ml/cmH}_2\text{O}$

Lung compliance = $VT / \text{End inspiratory } P_{PL} - \text{End expiratory } P_{PL} = 500 / 7 = 71.4 \text{ ml/cmH}_2\text{O}$