

PEEP

- PEEP refers to constant baseline pressure that is present throughout the ventilatory cycle.
- CPAP is PEEP during spontaneous breathing
- It is applied during the end of expiration to maintain the alveolar pressure above atm. pressure.

USES & MECHANISM:

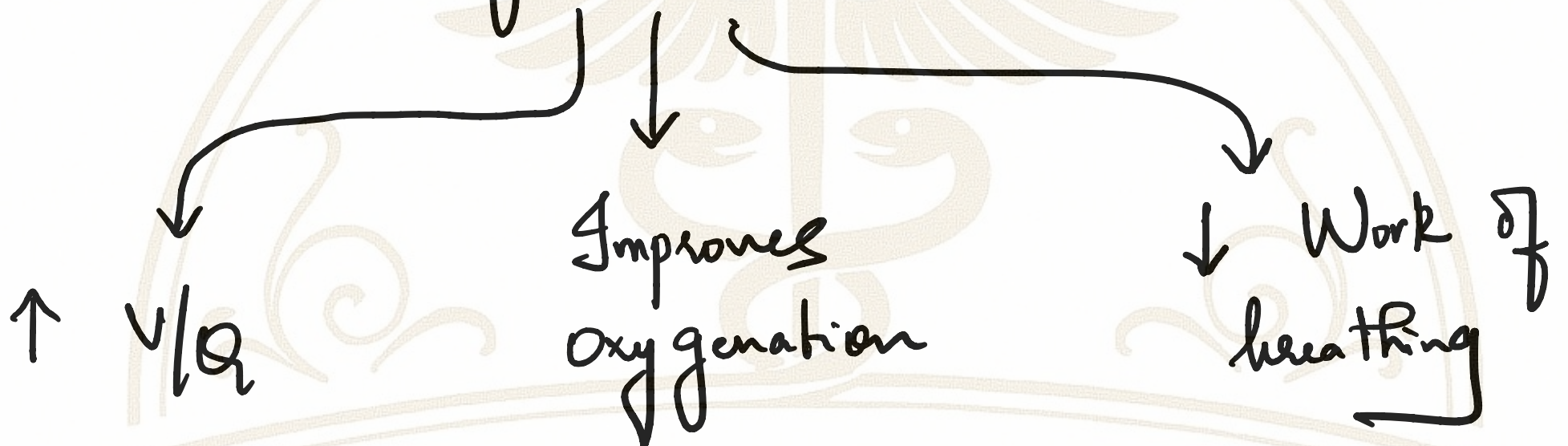
- PEEP improves oxygenation by preventing end expiratory collapse of alveoli & by recruiting non-ventilating (shunt) or poorly ventilated (low V/Q) alveoli [cyclic opening & closing of alveoli & distal bronchioles with each breath during ventilation, depletes surfactant & contributes to ventilator induced lung injury.]
 - ↓
- PEEP keeps the alveoli inflated & prevents cyclic opening & closing of alveoli.
- PEEP improves oxygenation in pts with pulmonary oedema by creating hydrostatic forces which move fluids from the alveoli & airways into the interstitium & by ↓ LV afterload

PHYSIOLOGY:

PEEP
↓

↓ alveolar distension pressure

↑ FRC by alveolar recruitment



MECHANISM OF PEEP

- 1) Recruitment of atelectatic alveoli
- 2) ↑ in dissolved arterial O_2 content
- 3) ↑ surface area of alveolar basement membrane
- 4) ↓ WOB
- 5) Redistribution of lung water from alveoli to interstitial space
- 6) Restoration of lung volume.

PEEP EFFECTS

* Effect of PEEP on PULMONARY PHYSIOLOGY

1) PEEP & FRC

- With PEEP, FRC remains above closing capacity
∴ ensuring alveoli remains open thro'out the respiratory cycle
- This ↑ time available for gas exchange, reduces V-Q mismatch & thereby improves oxygenation

2) PEEP & LUNG COMPLIANCE

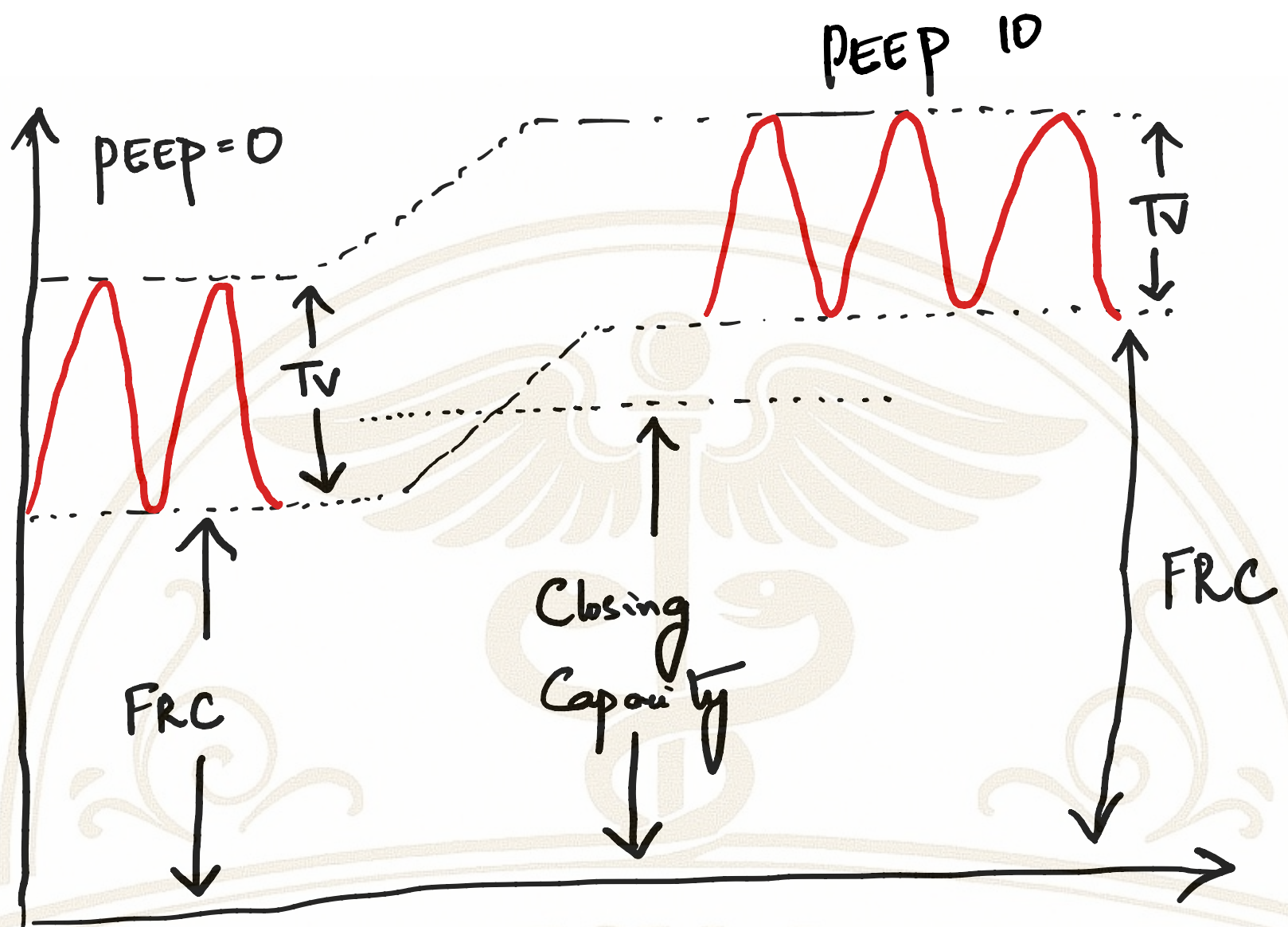
- PEEP opens up already collapsed alveoli. This is called alveolar recruitment
- With moderate PEEP, compliance of lung ↑
- With high PEEP, causes over distension, reduces lung compliance ↓

3) PEEP & V/Q MATCHING

- Supine mechanically ventilated pts have basal lung atelectasis.
- Application of moderate PEEP will open up these collapsed basal alveoli. → better ventilation & perfusion.

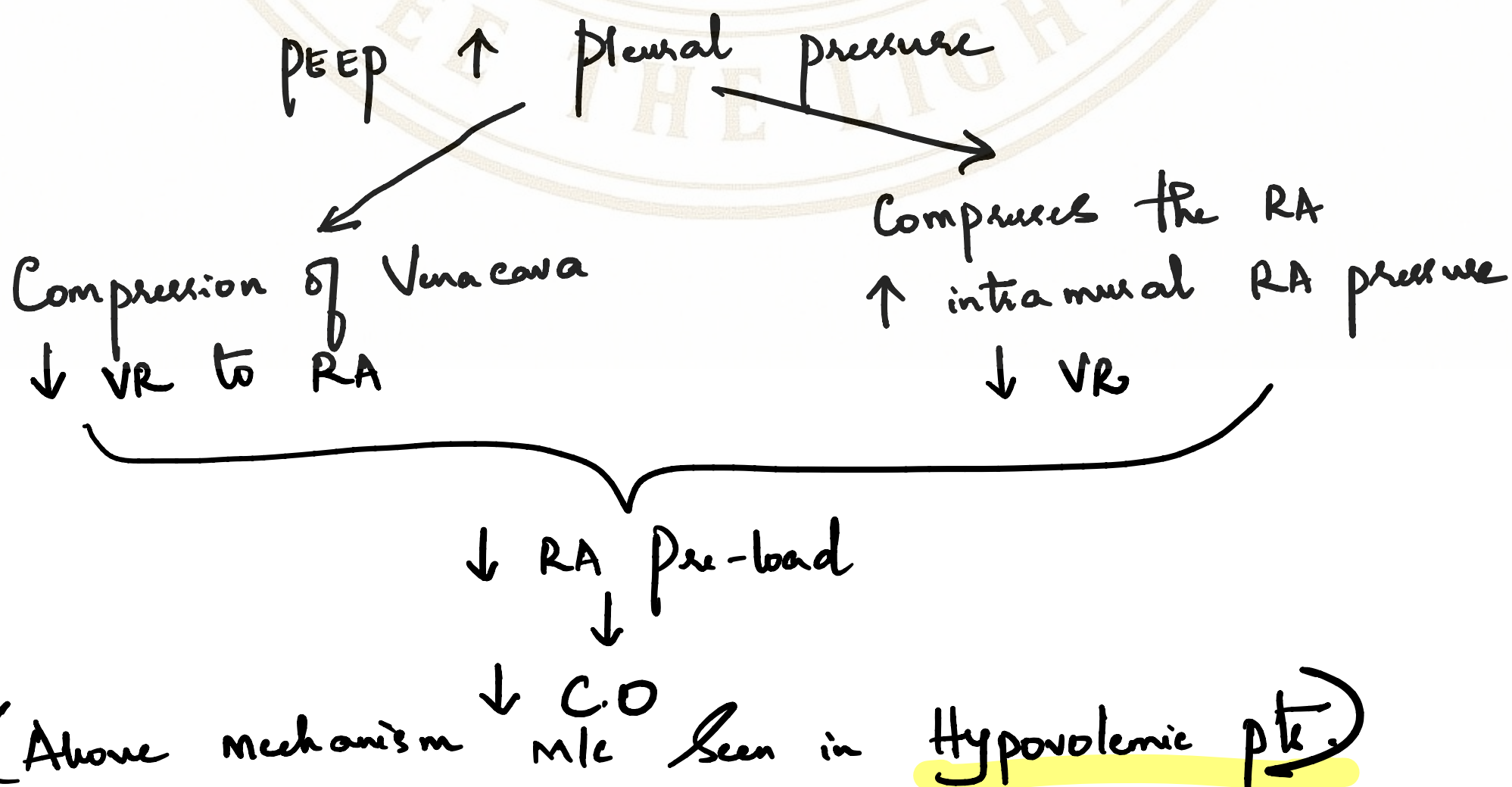
→ Excessive PEEP → over distension of already ventilated alveoli & convert them to WEST ZONES

Effect of PEEP on relationship between FRC & CC



* Effect of PEEP on Cardiovascular physiology

1) PEEP & RV PRELOAD



2) PEEP . PULMONARY VASCULAR RESISTANCE & RV AFTERLOAD

— ↑ in alveolar pressure on applying PEEP

↓
Pulmonary capillary compression in West Zone
↑ PVR — ↑ RV afterload.

— A very low end expiratory lung volume d/t inadequate PEEP can result in atelectasis, hypoxia & activation of hypoxic pulmonary vasoconstriction → raised PVR.

3) PEEP . LV FILLING & LV COMPLIANCE

PEEP causes rise in PVR

↓
↑ the RV pressure & RV dilatation.

↓
Pushes IV Septum to (L) side

↓
Reducing LV ejection

→ Raised Intra-thoracic pressure — (L) Ventricle
↓
Reducing its compliance & LV dispensability.

4) PEEP $\times$ LV AFTER LOAD

→ LV transmural pressure (difference btw end systolic LV pressure $\times$ intrathoracic pressure)

→ Application of PEEP or IPPV $\uparrow$ intrathoracic pressure

↓ LV transmural pressure $\times$ LV affected

→ The ability of PEEP to reverse LV failure by $\downarrow$ LV preload $\times$ afterload, thereby $\downarrow$ LV wall stress $\rightarrow$ $\downarrow$ myocardial O_2 demand thus moving the LV into a more efficient portion on Frank-Starling law.

→ Excessive PEEP can have a deleterious effect on RV fn.

Eg: In ARDS, where there is excessive RV strain.

* Effect of PEEP on cerebral Physiology

1) PEEP, ICP and Cerebral Perfusion Pressure

→ Rise in Intra-thoracic pressure d/t PEEP
↓
Compress the IVC → cerebral venous drainage
↓
↑ ICP

→ In hypoxic pts. with raised ICP; application of appropriate levels of PEEP is important

CONTRA INDICATIONS

- ① Hypotension - d/t volume depletion & dehydration
- ② Right Ventricular failure - PEEP ↑ RV afterload
- ③ (R) → (L) Intracardiac Shunt.
- ④ ↑ ICP + ↑ CVP (hypoxemia worsens neuronal damage, risk of ↑ ICP & PEEP must be balanced with likelihood of an improvement in oxygenation.

- ⑤ Pts with hyperinflation - Emphysema / COPD
Extrinsic PEEP can be used to balance auto PEEP in spontaneously breathing pts as it making triggering easier for these pts.
- ⑥ Bronchopulmonary fistula - High levels of PEEP may $\uparrow$ air leak $\therefore$ loss of ventilation.

GOAL OF PEEP:

To maintain $PaO_2 > 60$ & $SpO_2 > 90\%$ & acceptable pH

USES OF PEEP: ✖

- 1) To $\uparrow$ airway pressure - to improve oxygenation & alveolar recruitment
- 2) $\uparrow$ FRC - to prevent airway & alveolar collapse
- 3) $\uparrow$ Arterial O_2 tension (PaO_2)
- 4) Maximises recruitment of alveoli
- 5) Improved lung compliance
- 6) Decreased airway resistance
- 7) Decreased V/Q mismatch & shunt fraction

- 8) Improved distribution of Inspired gas
- 9) Decreased WOB
- 10) Prevention of Surfactant aggregation
reducing alveolar collapse
- 11) Decreased inflammatory response to
mechanical ventilation
- 12) ↓ LV afterload (dit ↓ LV transmural pressure)

ANAESTHESIA INSIGHTS

SEE THE LIGHT