Expiratory Retard

- Resistance to expiratory gas flow by using a restriction on the outflow port
- EEP = 0 cmH₂O

Expiratory Retard

- Methods
  - Caps with fixed orifice
  - Spring-loaded attachments
PEEP/CPAP

Expiratory Retard

Objective =

Considerations in Usage

1-
2-
3-
4-

PEEP =

1-
2-
3-
4-
5-
PEEP/CPAP

**PEEP**

Positive pressure maintained at end-expiration, i.e. pressure gauge does not return to 0 cmH₂O

---

**PEEP**

- Internal or external
- Flow resistor or threshold resistor valve

---

**Flow Resistor Valve**

- Create resistance to gas flow through an orifice
- Changes in exp gas flowrate $\propto$ pressure
- Technically is an exp retard device
  - If exp is long enough, baseline pressure returns to 0 cmH₂O
- Servo 900C, 300
Threshold Resistor Valve

- Produce constant pressure throughout exp phase regardless of gas flow rate or rate of ventilation
- Exp flow proceeds unimpeded until press falls to the preset "threshold" value → exp gas flow stops & PEEP is maintained
- Is not exp retard

Valves

- Underwater column
- H₂O-weighted diaphragm
Valves
- Weighted ball

Valves
- Spring-loaded

Valves
- Balloon
### Valves

- **Opposing flow**

![Diagram of Opposing flow](image)

### Valves

- **Magnetic**

![Diagram of Magnetic valves](image)

### Ambu Bags with PEEP

![Diagram of Ambu Bags with PEEP](image)
Pulmonary Effects of PEEP

- ↑ intrathoracic pressure

**Beneficial**
- ↑ PaO₂
- ↑ Cₐ
- ↓ Qₐ/Qₜ
- ↓ V_D/V_T

**Harmful**
- ↓ PaO₂
- ↓ Cₐ
- ↑ Qₐ/Qₜ
- ↑ V_D/V_T

Pulmonary Effects of PEEP

- ↑ Functional Residual Capacity
  - By:
    - 1-
    - 2-
  - Greater increase in FRC occurs where?

Pulmonary Effects of PEEP

- ↑ lung compliance
  - Only if decreased Cₐ was the problem
Pulmonary Effects of PEEP

↑ Intrathoracic pressure, ↑ FRC, & ↑ $C_L$

↓

↑ $PaO_2$

↓

$FeO_2$ ↓

Pulmonary Effects of PEEP

- When suctioning
  - No problem with $PaO_2$ if PEEP < 10 & HI-HO
    - Patient first
  - If PEEP > 10 cmH₂O → closed system
    - Required

- ↑ risk of barotrauma, esp. if PEEP > 20 cmH₂O or if $V_T$ are large

Cardiac Effects of PEEP

- ↓ venous return → ↓ $Q_T$
  - ↓ tissue perfusion
    - Hypotension
  - ↓ renal perfusion
  - ↓ cerebral perfusion

- Effect is immediate
- Correct - ↑ intravascular volume
Cardiac Effects of PEEP

- ↑ right ventricular afterload
- RV can dilate (to maintain stroke volume)
  - RV then encroaches on LV
  - LVEDV then decreases
  - LVSV decreases
- Q₁ decreases
- Correct - drugs

Cardiac Effects of PEEP

- Biventricular dysfunction
- PEEP can alter circulating concentrations of vasoactive agents
  - Affects strength of myocardial contractions
- To correct -

Cardiac Effects of PEEP

- ↑ intrathoracic pressure → ↑ CVP, ↑ PAP, ↑ PCWP
  - 1-
  - Trends most important
How Much PEEP?

- **Best PEEP** = PEEP level where $\text{PaO}_2$ is highest
- **Optimal PEEP** = PEEP level where $\text{PaO}_2$ is acceptable without harmful cardiovascular effects
- **Physiologic PEEP** = PEEP in normal lungs provided by glottic mechanism

---

Optimal PEEP Study

- Try various PEEP levels
- Measurements 15 - 30 min. after changes
- Return to “Optimal PEEP” level

---

Optimal PEEP Study

- Measurements:
  - **Basic**
  - **Intermediate**
  - **Advanced**
Optimal PEEP Study

<table>
<thead>
<tr>
<th>PEEP (cmH₂O)</th>
<th>PIP (cmH₂O)</th>
<th>Pplat (cmH₂O)</th>
<th>VT (ml)</th>
<th>Cst (ml/cmH₂O)</th>
<th>Q arterial (L/min)</th>
<th>PaO₂ (mmHg)</th>
<th>PAP (mmHg)</th>
<th>PCWP (mmHg)</th>
<th>Qt (cc/min)</th>
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</table>

Mask CPAP

- Requires patient who -
  - 1-
  - 2-
  - 3-
  - 4-
  - 5-
- Can be continuous (<12 - 36 hrs.) or treatments

Mask CPAP