Vent IV Respiratory Failure

- Medical Practice Improvement Project
- Paul Wisniewski, DO
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Cutting Edge
Surgical Medical Group

Disclosures

- None

Learning Objectives

1. Look at strategies for ARDS
2. Adjuncts to ventilation (Prostacyclin and NO)
3. When do you consider ECMO?

Next Week

Final Lecture in Vent Series

Difficult conditions and Trouble shooting

- Look at strategies for ARDS
- Adjuncts to ventilation (Prostacyclin and NO)
- When do you consider ECMO?

- Next Lecture January 30 , 2025

Look at strategies for ARDS

- Inversion of inspiration to Expiration Ratio. Longer times in Inhalation leads to higher mean airway pressure and improved oxygenation

- APRV (Airway Pressure Release Ventilation)
- Settings
- Time High (TH)
- Time Low (TL)
- Pressure High (PH)
- Pressure Low (PL)
- Rate = (TH + TL)/60 seconds

Airway pressure release ventilation (APRV) is a pressure control mode of mechanical ventilation that utilizes an inverse ratio ventilation strategy. APRV is an applied continuous positive airway pressure (CPAP) that at a set timed interval releases the applied pressure.

APRV (Airway Pressure Release Ventilation)

- Pressure ventilation

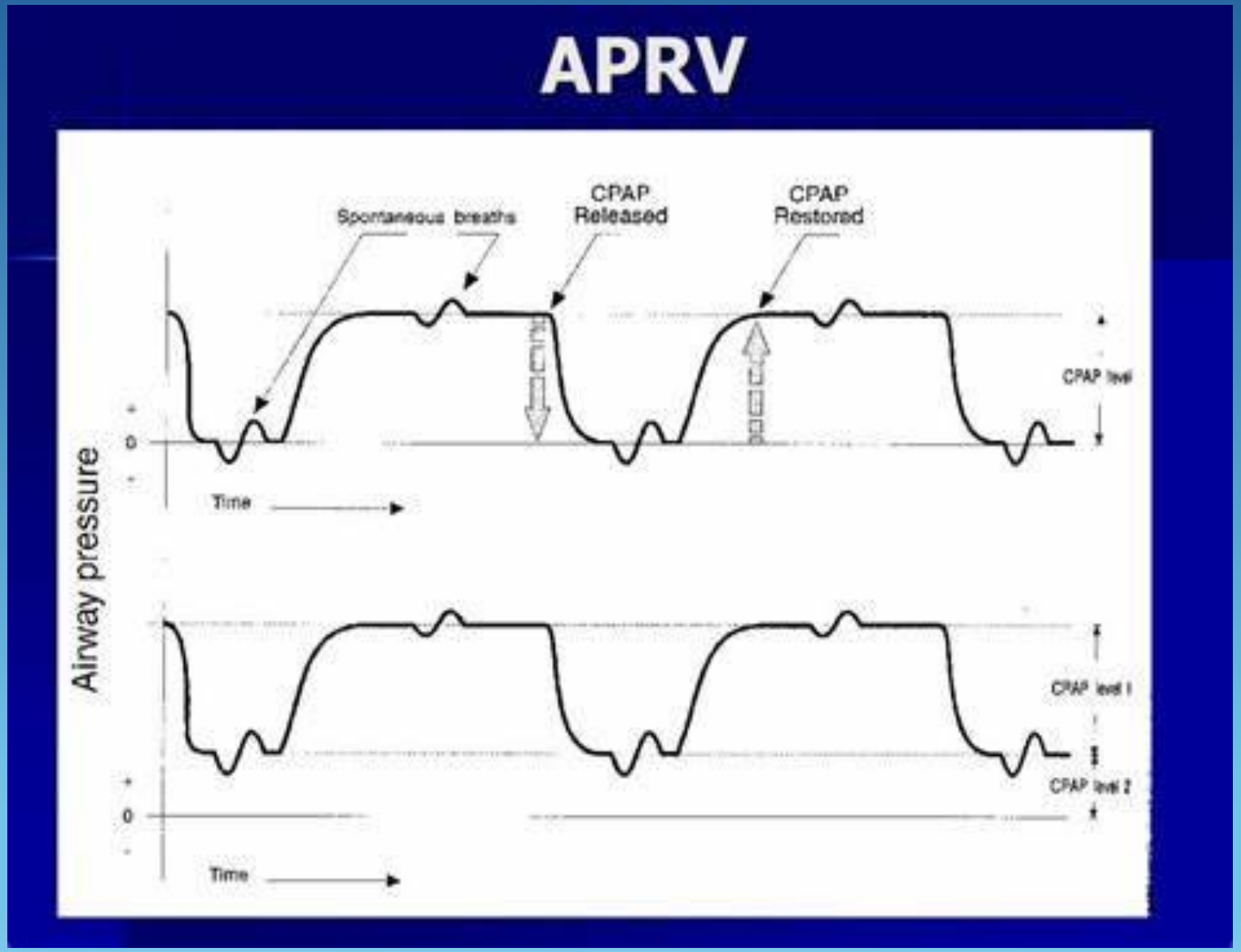
$$(PIP - PEEP) \cdot (T_I / T_{tot}) + PEEP$$

- Volume ventilation

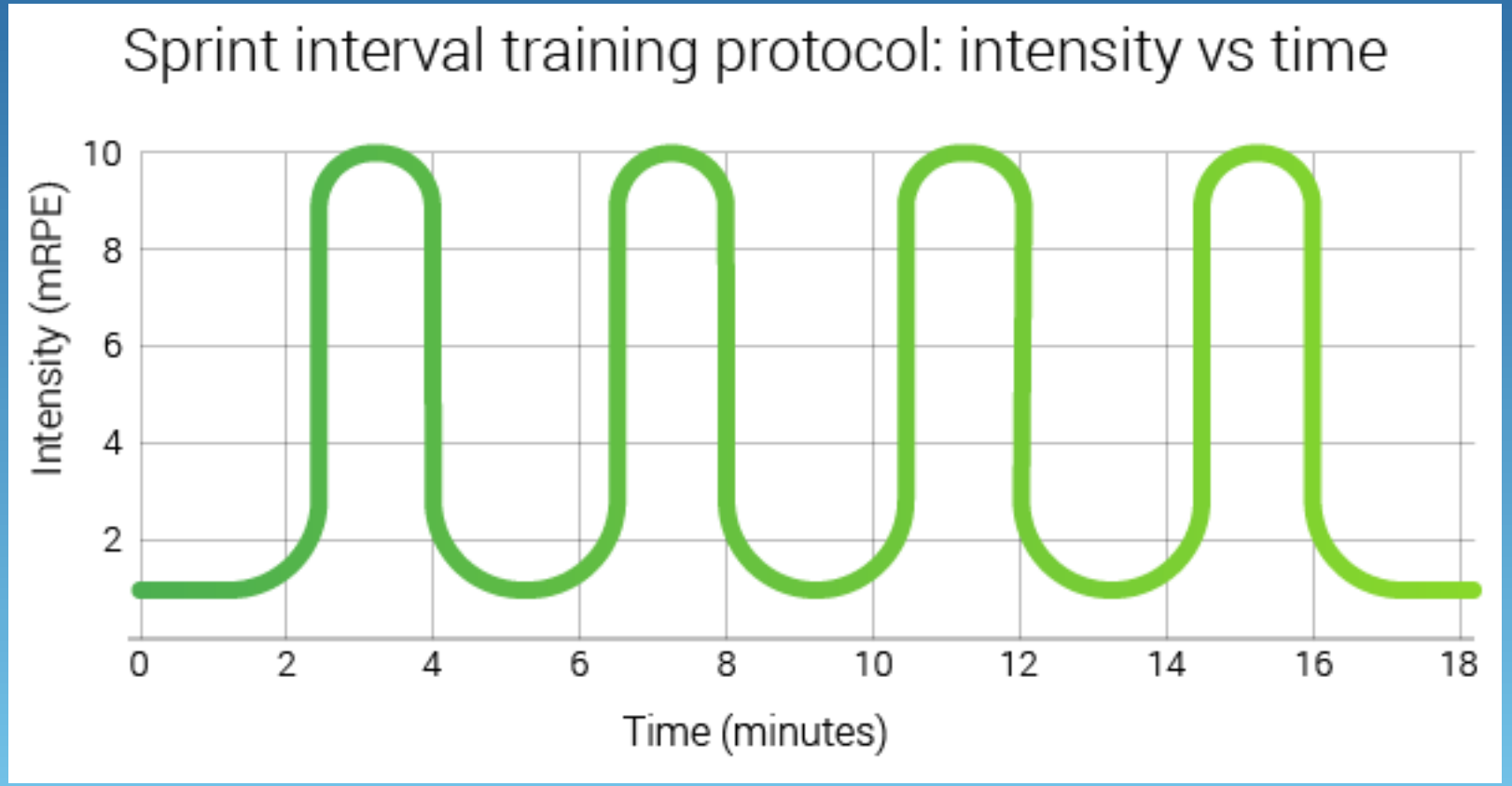
$$0.5 \cdot (PIP - PEEP) \cdot (T_I / T_{tot}) + PEEP$$

- Peep = PL
- FiO2 (same)
- Start
  - Time High (TH) = 5 to 6 sec
  - Time Low (TL) =.5-.8 sec
  - Pressure High (PH)= 25 cm H2O
  - Pressure Low (PL) = 0 cm H2O
  - Rate 10-12 BPM
  - FiO2- 50%-100%

APRV Tracing

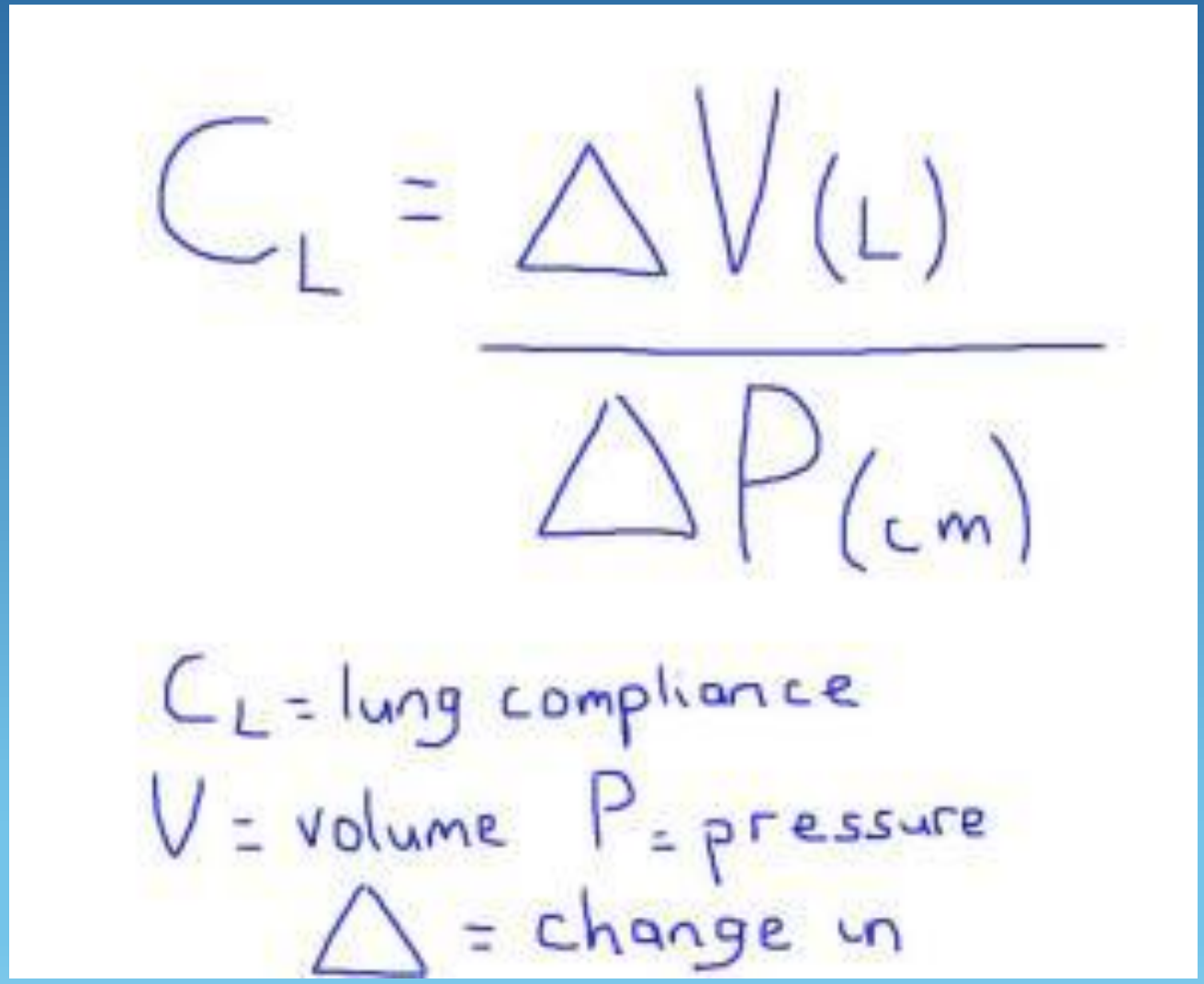


High Intensity Training Graph for intervals



Poor Lung Compliance

- Have to accept higher pressures to get more volume
- Have to accept lower minute ventilation to increase oxygenation which is the priority
- High PCO2 Level



Poor Lung Compliance

- Ways to increase compliance
  - Sedation for the patient
  - Paralyze the patient
  - Prone the patient?

Acute respiratory distress syndrome (ARDS) is a life-threatening condition characterized by poor oxygenation and non-compliant or "stiff" lungs. The disorder is associated with capillary endothelial injury and diffuse alveolar damage.

Prone the Patient?

Complications associated with placing the patient in the prone position and associated mortality include [1] [2] [3] [4] [5]:

- Decrease in cardiac index and stroke volume
- Tachycardia and increased peripheral vascular resistance
- Risk of pressure injuries
- Endotracheal tube obstruction
- Ocular and nerve injuries
- Enteral nutrition intolerance
- Increased risk of complications with continuous prone positioning
- Standardization of approach for managing cardiac arrest in the prone position.

Prone ventilation is a method of mechanical ventilation where the patient is positioned face-down. It is used in the treatment of **acute respiratory distress syndrome (ARDS)**. Here are some key points about prone ventilation in ARDS: uptodate.com +1

1. **Purpose**: Improve oxygenation when traditional ventilation methods fail.
2. **Mechanism**: Prone positioning redistributes blood and air flow more evenly, improving gas exchange. jamanetwork.com
3. **Benefits**: Reduced mortality and improved lung function. wikipedia.org +1
4. **Physiological Effects**: In the prone position, pleural pressure is less likely to exceed airway opening pressure, preventing airway closure. derangedphysiology.com

Early prone positioning can reduce mortality by 16% to 20% in patients with severe ARDS [1] [2]. Other studies have corroborated these findings, indicating that an early and prolonged duration of prone positioning can lead to significant physiological improvements in patients suffering from ARDS [3]. However, prior clinical trials showed that prone positioning improves oxygenation in patients with ARDS, without benefits in terms of survival [4]. In the PROSEVA trial, which demonstrated a beneficial effect of prone position on survival, 72% of patients in the prone position group received vasopressors, a rate not different from the control group [5].

Acute Respiratory Distress Syndrome

ARDS (Acute Respiratory Distress Syndrome) severity is determined by the **PaO2/FiO2 ratio**, which is calculated as follows: nursingcenter.com +1

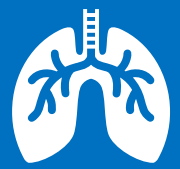
- Mild ARDS: 200 mm Hg < PaO2/FiO2 ratio ≤ 300 mm Hg with PEEP (positive end-expiratory pressure) or continuous positive airway pressure ≥ 5 cm H2O.
- Moderate ARDS: 100 mm Hg < PaO2/FiO2 ratio ≤ 200 mm Hg with PEEP ≥ 5 cm H2O.
- Severe ARDS: PaO2/FiO2 ratio ≤ 100 mm Hg. nursingcenter.com +1

Nitric Oxide

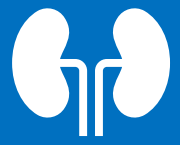
- It results in preferential pulmonary vasodilatation and lowers pulmonary vascular resistance.
- The route of administration delivers NO selectively to ventilated lung units so that its effect augments that of hypoxic pulmonary vasoconstriction and improves oxygenation.
- Inhaled NO increases blood flow toward ventilated areas of the lungs by dilating primarily those pulmonary vessels that are ventilated, which reduces intrapulmonary shunting, improves ventilation–perfusion matching, and therefore increases arterial oxygenation

- Start at 10-20 PPM can go as High as 40 PPM ($$$$$$)

Prostacyclin



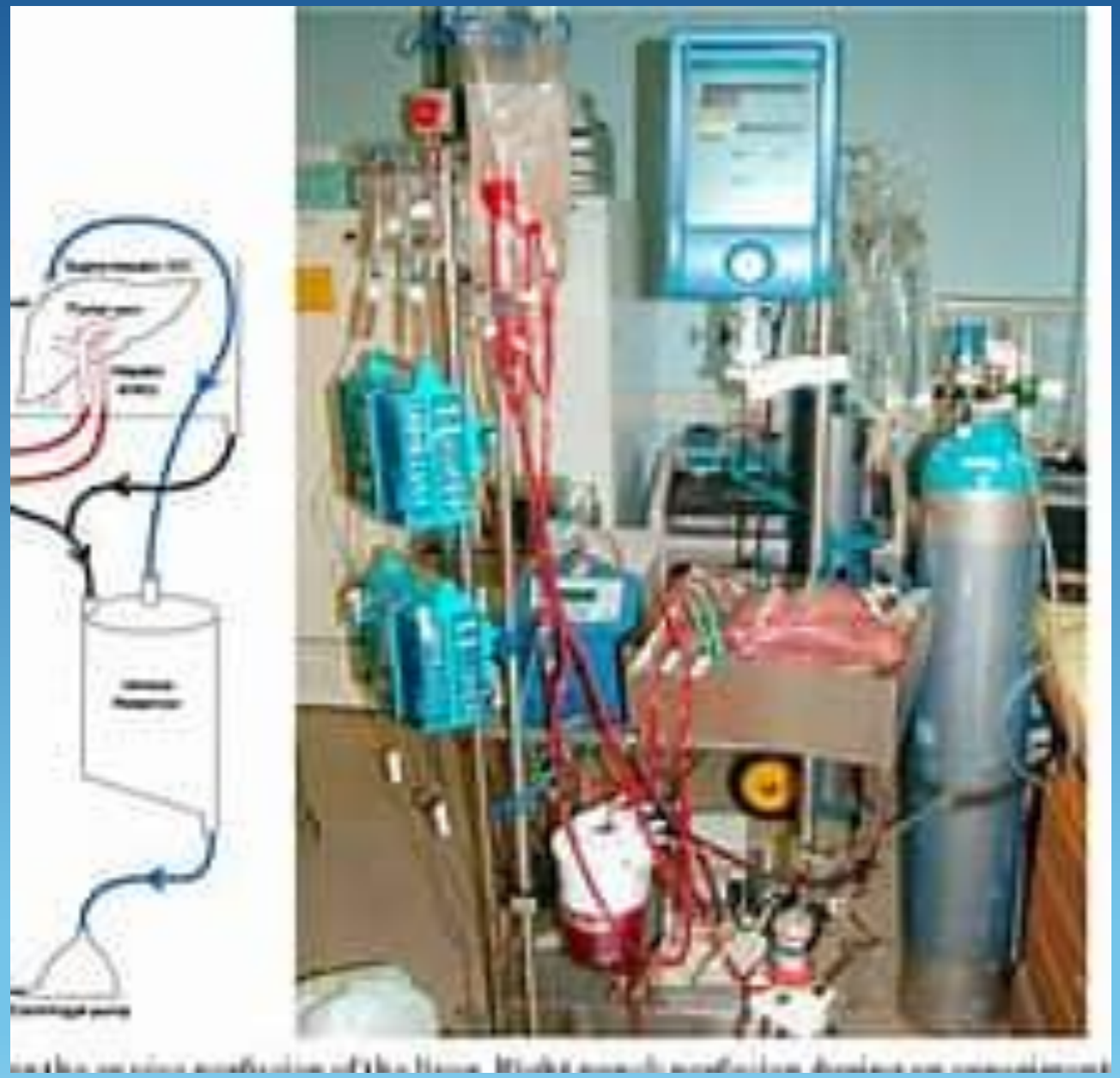
Prostacyclin can be administered as an aerosol to critically ill adults and children with **ARDS** to increase blood oxygen levels and improve survival



However, there is no current evidence to support or refute the routine use of aerosolized prostacyclin for patients with ALI and ARDS

Prostacyclin (also called **prostaglandin I_2** or **PGI_2**) is a prostaglandin member of the eicosanoid family of lipid molecules. It inhibits platelet activation and is also an effective vasodilator

Extracorporeal Membrane Oxygenation (ECMO)

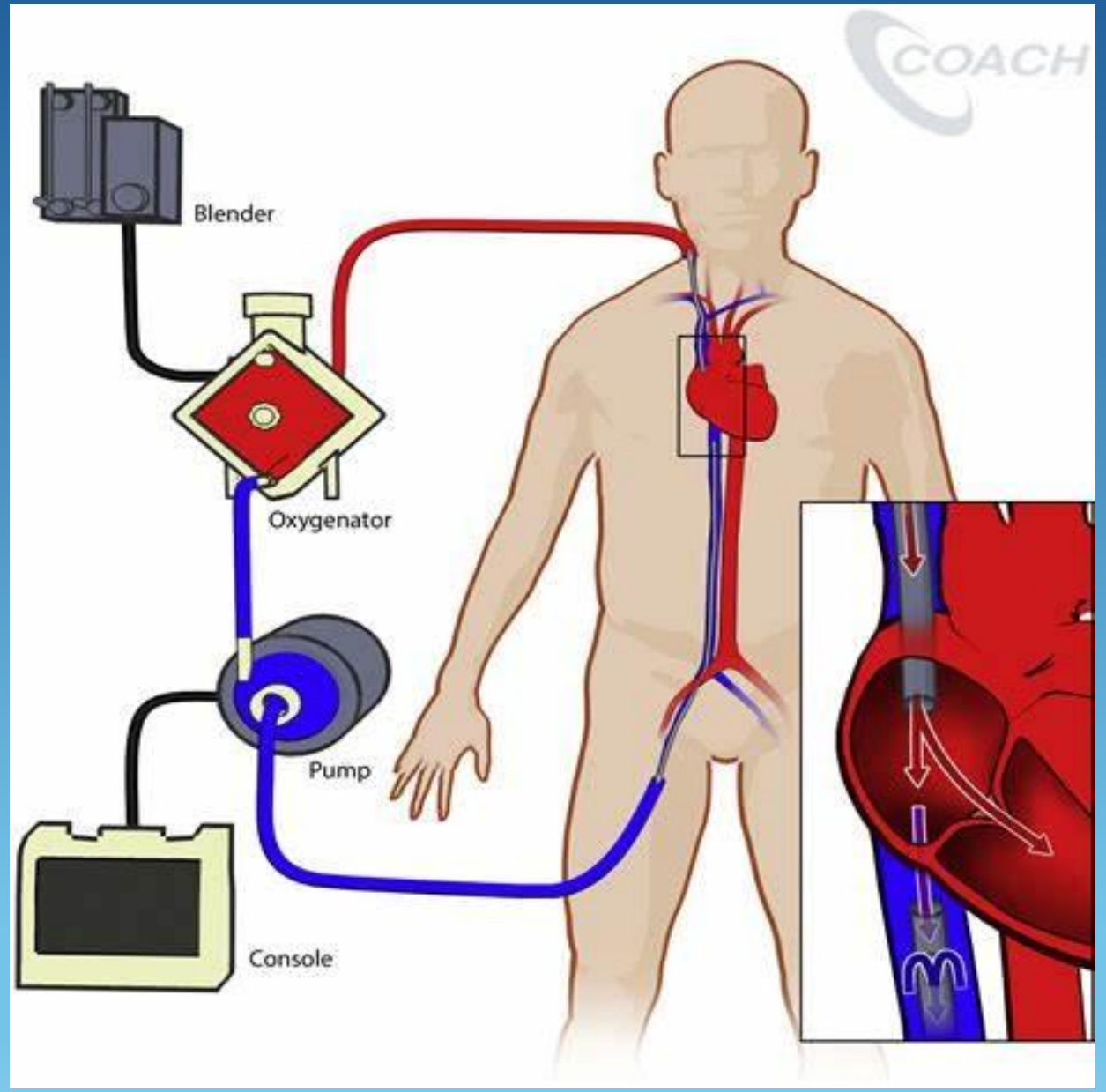


Extracorporeal membrane oxygenation

ECMO stands for extracorporeal membrane oxygenation. It is a form of partial cardiopulmonary bypass that provides either venoarterial (VA) or venovenous (VV) support. An ECMO machine takes blood from your veins, pumps it outside the body, removes carbon dioxide, adds oxygen, and returns it to your body. This process takes some of the workload off your heart or lungs or both.

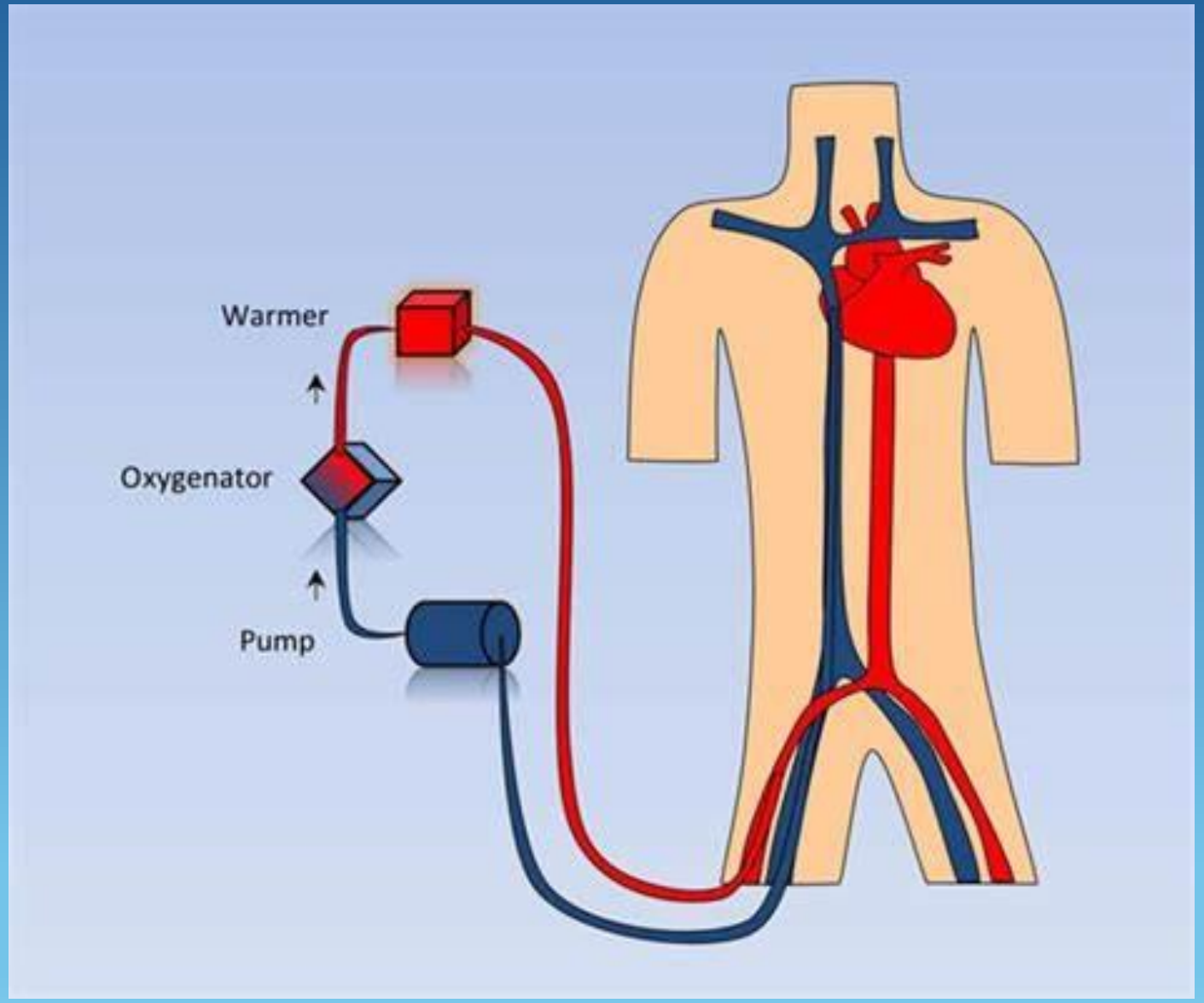
V-V ECMO (Veno-Venous Bypass)

- Used when lungs do now work. Hear still pumps



VenoArterial ECMO(VA)

- When the heart and lungs fail.
- NO Pump available
- ECMO is new Heart



ECMO In Trauma

- Has been used but
  - Can lead to ethical dilemmas
  - Bridge to transplant

  - End points and cost are prohibitive

Work Cited

- aprv mode - Search Images
- graph of high intensity work out to short rest interval - Search Images
- Prostacyclin – Wikipedia
- extracorporeal membrane oxygenation - Search Images

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