

Memo CIs

- Focus on patient-ventilator interaction
- In class Salomay & I will focus on:
 - Ventilator basics, what things mean, not how to do them, defining, explaining Vt etc., what is recommended as for settings in general. We will use cognitive questions, problems and case studies to practice and test students.
 - We will assign and use ABG, a/A ratio, and patient interaction intro software as part of above:
 - Shortcuts to all in the 178 folder
- In Lab with ventilator focus should be:
 - 1st basic operation and setting, monitoring, etc.'
 - 2nd altering compliance, resistance via test lung and having students record changes, not explain.
 - Can use 7200 certification software as part of above or other ventilator software we will provide.
 - Policies and procedures specific to our clinical affiliates.
 - Using new dataarc system for clinical grading.
 - SEE Exercise 1 attached, make each student fill out sheet and do and explain or respond to questions, or do in small groups.

RC-178 Class 1: Agenda

- Orientation
 - Classes & clinical schedule(More hours!)
 - this week - the following weeks
 - Syllabus, grading, clinical evaluations
 - Tests, software, etc.
 - Decorum, class vs clinical, anecdotal stories
 - Personal Causation Theory
- Patient-ventilator content PPTs
 - Patient-ventilator interaction
 - ABGs
 - a/A ratio
- Next week's reading, etc., and test 1!

Class/Clinical Schedule

- Class time, Physician lecture
 - This week vs following weeks
- Readings
 - Egan and other references
 - 2 hours for each hour of lecture
 - $7 \times 2 = 14$ hours study, reading, etc., *each week*
- Clinical/Lab Time(33hrs/wk 12 & 21)
 - Must do 8 to 12 hours clinical Max and remaining hours(of 33) in lab working on ICU competencies.
- Meeting dates, tests, final exam, clinical

Course Content

This course is an introduction to the practice of respiratory care in intensive care units with an emphasis on patient ventilator interaction. The student will manage critically ill patients on prolonged artificial ventilation using micro processor-driven ventilators, alarms, arterial blood gases and other appropriate techniques and equipment.

Students are rotated through evening, nights, and day critical care units in hospitals.

Lecture Outline

- **Arterial blood gas Interpretation**
- **a/A Ratio**
- **Basics of ventilators**
- **Ventilators and settings**
- **Maintaining desired pH & PACO₂**
- **Managing the patient/ventilator system**
- **Preventing nosocomial infections**

Course Objectives

1. Interpret arterial blood gases and classify according to clinical terms used in the management of adult patients on life support.
2. When given patient results at room air levels or higher, calculate FIO_2 and/or PaO_2 as a result of requested changes.
3. Identify use, settings, problems and indications for all alarms and monitoring devices found on adult artificial ventilators.
4. Identify and/or verbalize basic changes in FIO_2 , f , V_t , V_E , V_A , IFR, IE ratio, V_D etc., when given access to patient's ABG's, history, physical, and other appropriate information in order to manage adult patient ventilator interaction.
5. Conduct therapeutic procedures on critically-ill patients to achieve:
 - a. adequate arterial and tissue oxygenation
 - b. maintenance of a patent airway
 - c. removal of bronchopulmonary secretions
 - d. adequate spontaneous and artificial ventilation
6. Protect patient from nosocomial infections by adherence to infection control policies and procedures.

Tests, Software, Clinical Database

- Next Tuesday, Test 1
- Folders on the computers in lab
- Special software
 - ABG practice
 - 7200 ventilator
- Clinical database

Patient-Ventilator Interaction

Reason for ventilatory support
Control of oxygenation and acid-
base balance.

Other reasons for ventilatory
support.

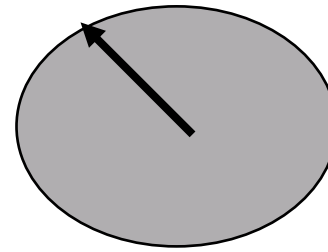
Suctioning, cuffs and alarms

Respiratory Failure

- The main reason people need ventilatory support.
- ABG values on R.A. no ventilatory assistance.
- Can be an Oxygenation problem, a ventilatory problem or both.

MACHINE RATE?

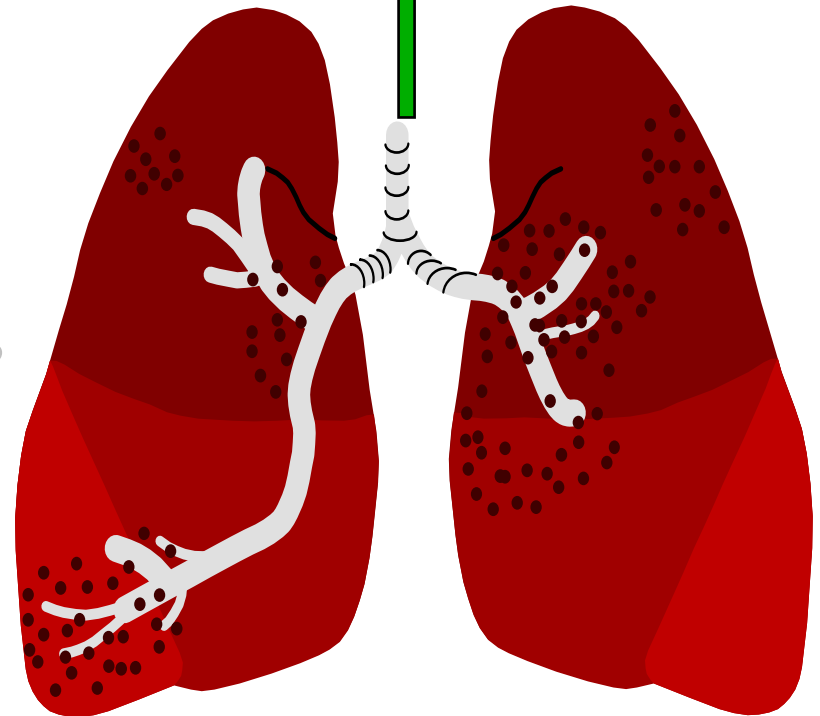
PIP?



**Vt?
Ve?**

7200
VENTILATOR

**ASSIST
OR
CONT.?**



SPONTANEOUS RATE?

Initial Ventilator Settings:

- $V_t = 10$ to 15 cc per Kg ideal body weight.
- Most use supernormal V_t for ventilatory support.
- RR = 12 to 15 unless patient is breathing, then back-up rate.
- $FIO_2 = .40$ until first ABG after ventilator support started.
- Wait 20-30 minutes after ventilation started or changes have been made.
- Mode = A/C

Patient-Ventilator Interaction

- Volume or pressure is dialed in to deliver to patient.
- Changes in patient's airways and lung inflation can be detected by watching the ventilator.
- PIP is one of the main indicators of change in pressure/volume needed to deliver a specific pressure/volume to the lung.
- Patient can trigger breaths, breathe spontaneously or get lock-out, be controlled

Estimations

1. Possible

“Anything is possible”, weak clinically!

2. Plausible

You have a logical, scientific rationale

3. Probable

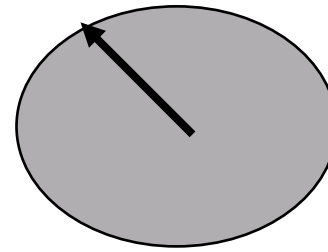
You have 1 and 2 and additional hard data and or experience to support your opinion

Some important equations:

- Acid/Base Balance
 - $\text{pH} = \text{Base} / \text{Acid}$
- CO2 Production
 - $\text{PaCO}_2 = \text{CO}_2 \text{ production} / \text{Minute VA}$
- Oxygenation of the blood by the lung
 - $\text{PaO}_2 / \text{PAO}_2 = \% \text{ of O}_2 \text{ diffusing across ACM}$
- Patient-Ventilator Interaction
 - $\text{PIP} = \frac{\text{AIRWAY RESISTANCE}}{\text{LUNG COMPLIANCE}}$

MACHINE RATE?

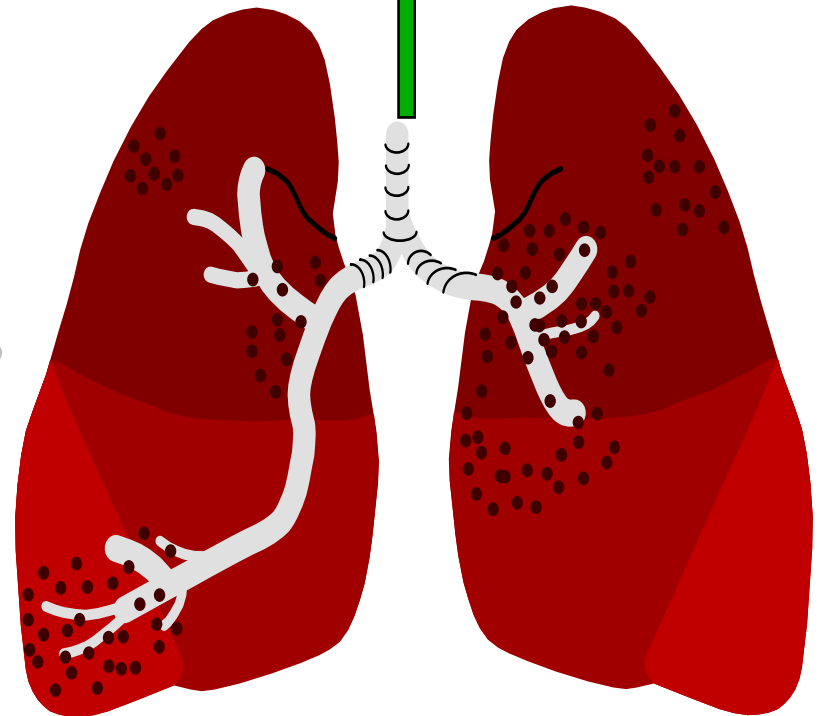
PIP?



**Vt?
Ve?**

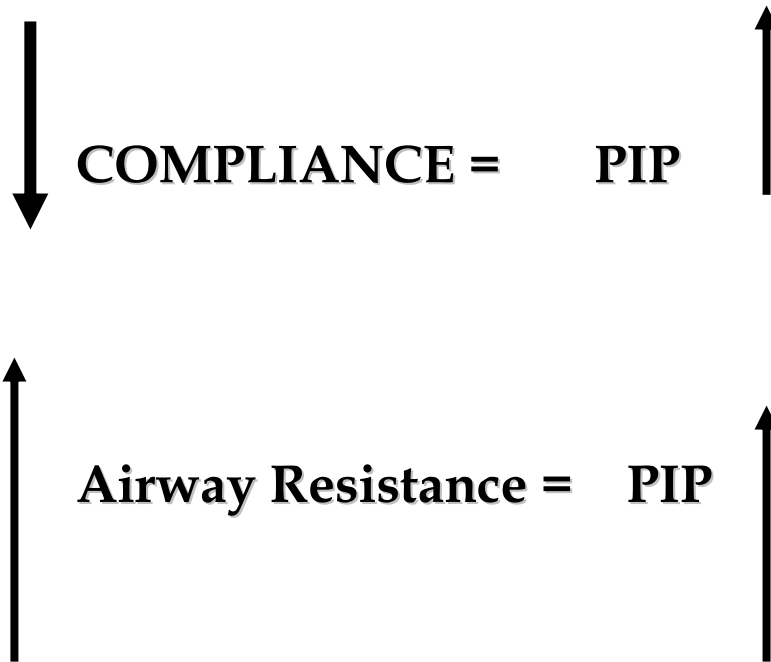
7200
VENTILATOR

**ASSIST
OR
CONT.?**



SPONTANEOUS RATE?

$$\text{PIP} = \frac{\text{AIRWAY RESISTANCE}}{\text{LUNG COMPLIANCE}}$$



PIP & THE PATIENT

AIRWAY RESISTANCE

$$\text{PIP} = \frac{\text{AIRWAY RESISTANCE}}{\text{LUNG COMPLIANCE}}$$

LUNG COMPLIANCE

↓ **COMPLIANCE = STIFFER LUNG**

↑ **AIRWAY RESISTANCE = SMALLER ID**



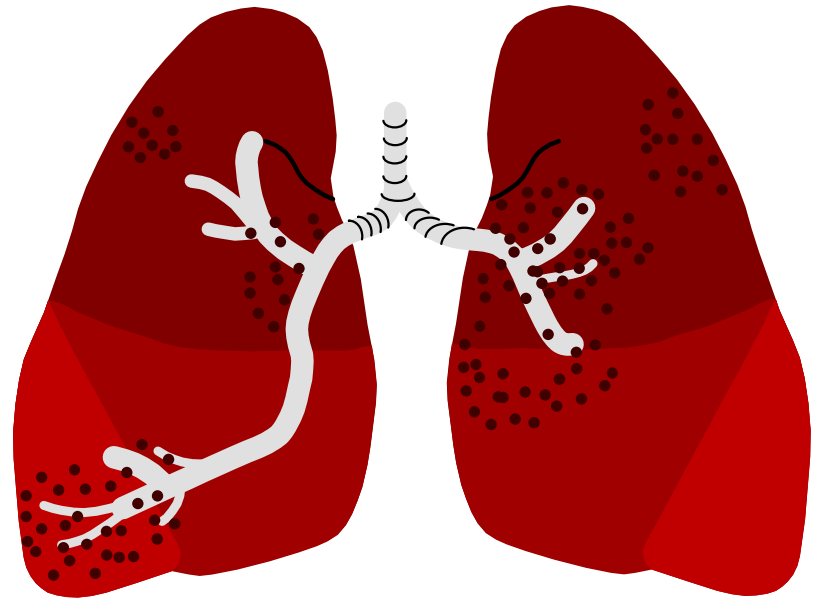
Alarms

- Low Pressure:
 - 5 to 10 cmH₂O < PIP.
- High Pressure:
 - 5 to 10 cmH₂O > PIP.
- Low Volume:
 - 50 to 100 cc below V_t/min.



CardioPulmonary Indices:

- Respiratory Rate
- Blood Pressure and heart rate.
- Skin color and appearance.
- Use of accessory muscles.
- MIP, VC, a/A, pH



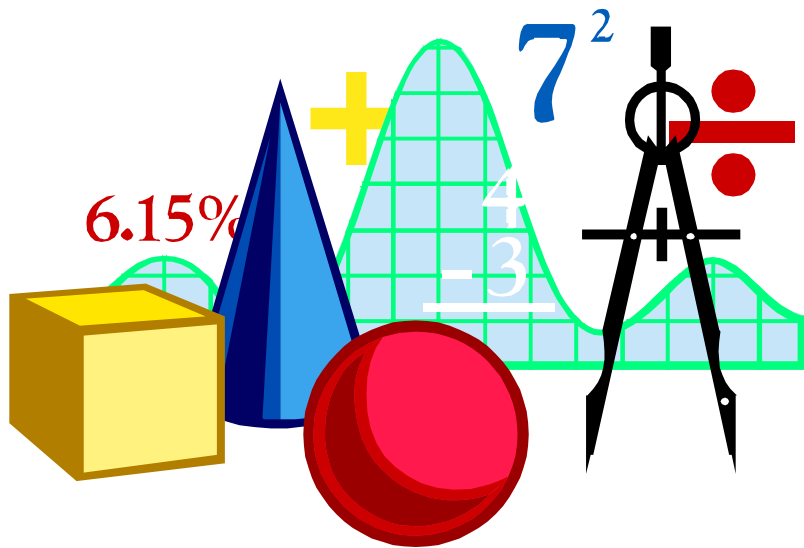
CHANGE IN PIP

- AIRWAY RESISTANCE:
 - BRONCHOSPASM
 - EDEMA
 - SECRETIONS
 - OBSTRUCTION
 - TUMOR
 - OTHERS...
- LUNG COMPLIANCE:
 - ATELECTASIS
 - PNEUMOTHORAX
 - PNEUMONIA
 - EDEMA
 - DISEASES
 - BANDAGES
 - GRAVITY

Switch to ABG's

- We will continue with this lecture module next week.
- Only up to this slide on Tuesday's test.

Changing PaCO₂ via V_e/min



- Current:
 - PaCO₂ x V_t x RR
 - Equals
- New:
 - PaCO₂ x V_t x RR
- Decide to how much to change PaCO₂.
- Decide to change V_t or RR.

Respiratory Failure

- The main reason people need ventilatory support.
- $\text{pH} < 7.25$, $\text{PaCO}_2 > 50$,
 - and/or $\text{PaO}_2 < 50$.
- ABG values on R.A. no ventilatory assistance.
- Can be an Oxygenation problem, a ventilatory problem or both.

Pulmonary Hypoxia vs Respiratory Acidosis

- Hypoxia:
 - PaO₂ below 50 on RA
 - May not respond well to increased FIO₂
 - Considered a life threatening drop in PaO₂.
 - Lungs have failed
 - a/A ratio will be low
- Acute Respiratory Acidosis/Failure:
 - pH < 7.26
 - PaCO₂ > 50
 - HCO₃ near normal
 - Cannot maintain near normal pH
 - Life threatening pH
 - Lungs have failed
 - a/A could be near normal

BREAK TIME !!



True or False

IF CO₂ PRODUCTION INCREASES, AND MINUTE ALVEOLAR VOLUME DOESN'T CHANGE THEN PaCO₂ WILL DECREASE.

True or False

When the low exhaled volume alarm sounds on a volume-cycled ventilator a plausible cause may be a leak in the patient-ventilator system.

True or False

Normal ABGs are the best indicator that you have reached your goal of reversing respiratory failure in a post-op patient you just placed on a ventilator in the last 20 minutes to 1 hour.

If the patient is being ventilated by ventilator and the patient's lungs become more difficult to ventilate, alarms start ringing, the 1st concern directly related to this change that we should focus on at the bedside immediately is:

- a.) patient's Skin color**
- b.) patient's Tidal Volume**
- c.) patient's Minute Volume**
- d.) patient's Respiratory Rate**
- e.) patient's PaO₂ and or Sat%**

What about Heart Rate!

If a patient on a volume-cycled ventilator needs suctioning, the most common ventilator response would be:

- a.) a drop in expired tidal volume**
- b.) an increase in respiratory rate**
- c.) an increase in the system pressure**
- d.) a significant change in the I:E ratio**
- e.) a significant increase in the oxygen concentration**

When using the 7200, if PIP increases, possible causes is/are:

I. Leak in the expiratory valve.

II. Mucus build-up in airways.

III. Acute Bronchospasm.

a.) I only

b.) II and III only

c.) I and II only

d.) I, II and III

e.) II only

Which of the following will produce the highest MITP?

- a.) Spontaneous breathing**
- b.) Incentive spirometry**
- c.) Intermittent positive pressure breathing**
- d.) Continuous positive airway pressure**
- e.) Continuous artificial ventilation with PEEP.**

Patient-Ventilator Interaction Continued...

- Airway Protection.
- Patient cannot be weaned.
- Decrease ICP.
- Stabilize/treat chest injury.
- Decrease WOB.
- Decrease Work on Heart.

Cuffs

- Airway Protection
- MOV and MLT
 - volume needed to just occlude airway
 - volume needed to leave a small leak
- MOV is more dangerous to airway
 - pressure can cause tracheal stenosis
- MLT is more dangerous to airway
 - leak can allow patient to aspirate

Cuffs Continued...

- Tracheal Stenosis:
 - 20 mmHg or less is safe
 - 30 mmHg or more is unsafe
 - 20 - 30 is gray area
 - many test makers and textbooks use 25mmHg.
- Aspiration:
 - cuff must be leaking
 - no gag reflex or position of patient

Suctioning

- Duration: 10 to 15 seconds from disconnection of ventilator.
- Size: never exceed $1/2$ the ID of trach tube.
- Rotate vs intermittent
- Type of catheter

Suctioning continued...

- Hazards of suctioning:
 - Hypoxemia
 - Tachycardia
 - Bradycardia
 - Vagal nerve stimulation
 - Micro-Atelectasis

Suctioning continued...

- Procedure:
 - Monitor patient HR, Sat.% for baseline
 - Preoxygenate: increase FIO₂ to >90%*
 - Observe proper Infection Control
 - Disconnect ventilator
 - Suction 10-15 seconds
 - Reconnect ventilator
 - Repeat as needed
 - Post-oxygenate: increase FIO₂ to >90%*

*** Observe hospital and specific patient policy**

Exercise 1

- Demonstrate, ventilator on test lung controlled rate, V_t , etc.
- Change compliance, note changes in V_t , Rate, ratio, PIP, etc
- Change airway resistance, note same...
- Change Peak flow, note...
- Change Rate, note...
- Change Flow curve, note...
 - Be ready to answer oral questions about your data
 - Oral performance to be part of course grade

Patient cannot be weaned

- Patient fails weaning attempt:
 - Increase HR
 - Diaphoresis
 - Drop in O₂ Saturation %
 - Increase RR
 - Drop in Tidal Volume
 - Use of accessory muscles
 - Intercostal retractions

Patient cannot be weaned continued...

- **Was patient assessed properly before failed weaning attempt:**
 - **Stabilized condition**
 - **Treated original cause of RF or need for PAV**
 - **ABGs stable for reasonable period of time**
 - **Weaning parameters indicating long term probability of successful weaning**
 - **Muscle tone**
 - **Nutrition balance**

Decrease ICP

- ICP increase after brain injury or trauma
- Increased ICP can cause further brain damage
- PaCO₂ effects cerebral blood flow
- Use ventilator to control PaCO₂ and thus control cerebral blood flow
- Cerebral blood flow can raise or lower ICP

Stabilize/treat chest injury

- O2 and CO2 main function:
 - still working?
- Airway protection and maintenance:
 - can we do it without intubation and ventilator?
- Special settings to stabilize chest needed?
 - Paradoxical breathing and bad ABGs
- Chest tubes
 - Use to rein late a collapsed lung
 - Advanced technique, cover later, do not touch and do not jump to any conclusions, like what the bubbling means.

Decrease Work of Breathing

- To breathe “cost” muscle action and thus work effort(WOB).
 - See work of heart slide, all still applies.
 - Use ventilator to do this, the mode, flowrate, sensitivity, etc., must all be set to facilitate a decrease in the work effort of the patient to breathe.
 - Patient-ventilator interaction must be checked:
 - Patient’s appearance(working or resting?)
 - Accessory muscle use(there should be none)
 - O2 Sat% high enough to support good tissue oxygenation(>90)
 - 16 times less efficient muscle work without sufficient O2
 - Pressure gauge needle rising, but then falls, then increases
 - Inadequate IFR

Decrease Work on the Heart

- To breathe “cost” muscle action and thus work effort(WOB).
 - We pay for this work with Oxygen delivered to the working muscles.
 - The more work the muscles have to do, the higher the Oxygen cost.
 - The more Oxygen that has to be delivered, the harder the heart works-Fick equation:

$$CO = \frac{O_2 \text{ CONSUMPTION}}{a-v O_2 \text{ DIFF}} \times 100$$