Mechanical Ventilation

Educational Reinforcement Material

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Pre-Test Questions

1. Which of the following is not the main goal of mechanical ventilation in the ICU?
    a. Optimize patient comfort
    b. Optimize exchange of carbon dioxide and oxygen
    c. Get them through surgery with less discomfort
    d. Decrease work of breathing
2. What are ways to maximize patient comfort on the ventilator?
    a. Optimize ventilation settings
    b. Sedation
    c. Paralytics
    d. All of the above
3. What is the optimal type of breath?
    a. Spontaneous
    b. Controlled
    c. Assisted
    d. None of the above
4. Will all patients have perfect carbon dioxide and oxygen levels?
    a. Yes
    b. No
5. What should the carbon dioxide goal be with traumatic brain injury?
    a. High to allow increased cerebral blood flow
    b. High to prevent increased cerebral blood flow
    c. Normal to prevent increased cerebral blood flow
    d. Normal to allow increased cerebral blood flow
6. Which of the following is not a toxicity with mechanical intubation?
    a. Hypercarbia
    b. Barotrauma
    c. Volutrauma
    d. Atelactotrauma
    e. Oxygen toxicity
7. What percent of oxygen can lead to oxygen toxicity (even if only a short period of time)?
    a. >50 %
    b. >60%
    c. >70%
    d. >80%
8. What is the volume of gas in the lungs at the end of expiration, but prior to inhalation?
    a. Inspiratory Capacity
    b. Expiratory Capacity
    c. Vital Capacity
    d. Tidal Volume
    e. Functional Residual Capacity
9. Is inhalation an active or passive process?
    a. Active
    b. Passive
10. What happens to the intrathoracic pressure/ volume when you inhale?
    a. ↑ intra-thoracic pressure: ↑intra-thoracic volume
    b. ↑ intra-thoracic pressure: ↓intra-thoracic volume
    c. ↓ intra-thoracic pressure: ↑intra-thoracic volume
    d. ↓ intra-thoracic pressure: ↓intra-thoracic volume
11. Is exhalation an active or passive process?
    a. Active
    b. Passive
12. What happens to the intrathoracic pressure/volume when you exhale?
    a. ↑ intra-thoracic pressure: ↑intra-thoracic volume

   b. ↑ intra-thoracic pressure: ↓intra-thoracic volume
   c. ↓ intra-thoracic pressure: ↑intra-thoracic volume
   d. ↓ intra-thoracic pressure: ↓intra-thoracic volume
13. When does exhalation become an active process?
   a. With restrictive lung disease
   b. After you run a mile
   c. With obstructive lung disease
14. Mechanical ventilation works by_____?
   a. Positive pressure- pushing air into the lungs
   b. Negative pressure- pulling out the chest wall
15. Which of the following is not a way to improve oxygenation?
   a. FiO_2
   b. PEEP
   c. Inspiratory time
   d. Respiratory rate
16. What is mean airway pressure?
   a. Average pressure that alveoli are exposed to during inspiration
   b. Average pressure that the lungs are exposed to during expiration
   c. Average pressure the lung is exposed to during mechanical ventilation
17. What is the normal I:E ratio?
   a. Inspiration is longer than expiration
   b. Expiration is longer than inspiration
   c. Inspiration and expiration are equal
18. How does increasing the inspiratory time lead to improved oxygenation?
   a. It increases mean airway pressure
   b. It decreases expiration time
   c. It improves PEEP
   d. It increases the tidal volume
19. What is removal of carbon dioxide from the body called?
   a. Hypercarbia
   b. Hypocarbia
   c. Ventilation
   d. Tidal Volume
20. What is the equation for minute ventilation?
   a. Respiratory Rate X PEEP
   b. Respiratory Rate X Tidal Volume
   c. Tidal Volume X Expiratory Time
   d. Expiratory Time X Respiratory Rate
21. What is dead space ventilation?
   a. Carbon dioxide in the unventilated alveoli
   b. Carbon dioxide delivered to the patient if the patient isn't on 100% oxygen
   c. Carbon dioxide that is unable to diffuse out of the capillaries
   d. Carbon dioxide still in the airway at expiration
22. How does increasing the tidal volume allow more CO2 removal?
   a. Allows more surface area for the transfer of CO2
   b. Increases the mean airway pressure
   c. Allows the alveoli to remain open longer for gas exchange
   d. Improves compliance
23. Since tidal volume is limited, what else can we adjust to improve minute ventilation?
   a. Inspiratory time
   b. FiO_2
   c. Respiratory Rate
   d. Expiratory time
24. Why do patients with obstructive lung disease need a shorter respiratory rate?
   a. Gives the patients time to rest

   b. Shorter respiratory rate allows a longer expiratory time as they have trouble with air removal
   c. Shorter respiratory rate allows for less positive end expiratory pressure
   d. Shorter respiratory rate allows for longer inspiratory time to improve oxygenation
25. What is the injury to the alveoli caused by excessive pressure from the ventilator called?
   a. Barotrauma
   b. Volumtrauma
   c. Atelectotrauma
   d. Biotrauma
   e. Oxygen toxicity
26. What is the injury from over distension of the alveoli from excessive tidal volume called?
   a. Barotrauma
   b. Volumtrauma
   c. Atelectotrauma
   d. Biotrauma
   e. Oxygen toxicity
27. What is the injury from repetitively opening and closing lung units (a type of sheering stress to the lung) called?
   a. Barotrauma
   b. Volumtrauma
   c. Atelectotrauma
   d. Biotrauma
   e. Oxygen toxicity
28. What is the lung injury resulting from inflammatory mediators called?
   a. Barotrauma
   b. Volumtrauma
   c. Atelectotrauma
   d. Biotrauma
   e. Oxygen toxicity
29. What is the lung injury due to oxygen production of free radicals called?
   a. Barotrauma
   b. Volumtrauma
   c. Atelectotrauma
   d. Biotrauma
   e. Oxygen toxicity
30. What happens with inadequate PEEP?
   a. Alveoli collapse and develop atelectasis
   b. Poor compliance
   c. Inadequate minute ventilation
   d. Higher oxygen requirements leading to oxygen toxicity
31. What happens with adequate PEEP?
   a. Better driving pressure
   b. Less pressure is needed to re-expand the alveoli at the end of expiration
   c. Improved minute ventilation
   d. Lower oxygen requirements thus decreasing risk of barotrauma
32. What is the difference between the plateau pressure (PPlat) and the positive end expiratory pressure (PEEP)?
   a. Driving pressure
   b. Static pressure
   c. Dynamic Pressure
   d. Compliance
33. What happens to blood return with spontaneous breathing?
   a. Positive intrathoracic pressure that causes less resistance and assists in venous return
   b. Negative intrathoracic pressure that causes increased resistance and impedes in adequate venous return

   c. Positive intrathoracic pressure that causes increased resistance and impedes venous return
   d. Negative intrathoracic pressure that causes less resistance and assists in venous return
34. What happens to blood return to the right atrium with positive pressure ventilation?
   a. Positive intrathoracic pressure that causes less resistance and assists in venous return
   b. Negative intrathoracic pressure that causes increased resistance and impedes in adequate venous return
   c. Positive intrathoracic pressure that causes increased resistance and impedes venous return
   d. Negative intrathoracic pressure that causes less resistance and assists in venous return
35. How can you help improve venous return in a patient on positive pressure ventilation?
   a. If the patient has decreased intravascular volume, a fluid bolus will help
   b. Higher levels of positive end expiratory pressure (PEEP)
   c. Increase the volume/pressure breath (depends on the mode)
   d. Trial of bronchodilators to decrease afterload
36. What happens to the right ventricle with positive pressure ventilation?
   a. Decreased right ventricular afterload
   b. Increased right ventricular preload
   c. No significant changes to the right ventricle
   d. Increased right ventricular afterload
37. What happens if you intubate a patient with RV failure?
   a. Nothing with rapid sequence intubation technique
   b. Improved pre-load to the RV
   c. RV collapse and cardiac arrest
   d. Increased ejection fraction of the right ventricle
38. What happens to the left ventricle with positive pressure ventilation?
   a. Increased stroke volume and increased cardiac output
   b. Decreased stroke volume and decreased cardiac output
   c. Increased heart rate and increased cardiac output
   d. Decreased heart rate and decreased cardiac output
39. Is positive pressure good or bad with heart failure? Why?
   a. Bad; increases afterload and deceases cardiac output
   b. Good; decreases preload and increases cardiac output
   c. Bad; decreases preload and decreases cardiac output
   d. Good; decreases the LV afterload and allows more cardiac output
   e. Depends on the type an etiology of heart failure

40. Which of the following is not a type of breath that can be delivered by a ventilator?
    a. Controlled
    b. Assisted
    c. Manuel
    d. Spontaneous
41. What are the two types of breath delivery?
    a. FiO_2, PEEP
    b. Volume, pressure
    c. Flow, volume
    d. Respiratory rate and tidal volume
42. What type of breath requires no work by the patient, as the frequency/rate of the breath and the amount of gas delivered is fully dependent on the ventilator?
    a. Controlled
    b. Assisted
    c. Manuel
    d. Supported
43. Describe the type of breath when the patient starts the process (aka triggers a breath), but the ventilator takes over.
    a. Controlled
    b. Assisted
    c. Manuel
    d. Supported
44. With what type of breath does the patient do most/all of the work, and the ventilator gives only minimal assistance, if needed?
    a. Controlled
    b. Assisted
    c. Manuel
    d. Supported
45. What is controlled mandatory ventilation (CMV)?
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
46. What is pressure support?
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
47. What is assist controlled ventilation (ACV)?
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
48. What is synchronized intermittent mandatory ventilation (SIMV)?
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
49. In which mode of ventilation is a pre-set amount of gas delivered to the patient?
    a. Volume breath

b. Pressure Breath
c. Both
d. Neither

50. When giving a volume breath, at what pressure will the gas be delivered?
    a. Depends on compliance
    b. 6-8 ml / kg of ideal body weight
    c. Depends on the respiratory rate
    d. Depends on the flow and inspiratory time
51. When giving a volume breath, what is the relationship between compliance and pressure?
    a. Higher the pressure, higher the compliance needed
    b. Lower the compliance, higher the pressure needed
    c. Lower the pressure, lower the compliance needed
    d. Higher the compliance, higher the pressure needed
52. In which mode of ventilation will a pre-set pressure deliver gas to the patient?
    a. Volume breath
    b. Pressure Breath
    c. Both
    d. Neither
53. When giving a pressure breath, how much volume of gas will be delivered to a patient?
    a. Depends on compliance
    b. 6-8 ml / kg of ideal body weight
    c. Depends on the respiratory rate
    d. Depends on the flow and inspiratory time
54. When giving a pressure breath, what is the relationship between compliance and volume?
    a. Lower compliance, the less volume delivered
    b. Lower compliance, the more volume delivered
    c. Higher volume, the higher the compliance needed
    d. Lower volume, the higher the compliance needed
55. Which is a dynamic pressure needed to fully inflate the lungs and overcome the resistive forces and elastic forces of the lungs?
    a. Peak Inspiratory Pressure (PIP)
    b. Positive end expiratory pressure (PEEP)
    c. Plateau pressure (PPlat)
    d. End Expiratory Pressure
56. What is the normal peak inspiratory pressure (PIP)?
    a. Variable depending on body habitus
    b. >20 cm of water pressure
    c. <10 cm of water pressure
    d. <20 cm of water pressure
57. What is a static pressure that the alveoli see?
    a. Positive end expiratory pressure (PEEP)
    b. Driving pressure
    c. Plateau pressure (PPlat)
    d. Peak Inspiratory Pressure (PIP)
58. What is meant by a static pressure vs dynamic pressure?
    a. Dynamic is seen during an inspiratory hold, whereas static is the same as the Peak inspiratory pressure (PIP)
    b. Static has no air movement, dynamic pressure has air movement
    c. Same thing: static pressure is used with volume mode and dynamic pressure with pressure mode
    d. Same thing: static pressure is used with pressure mode and dynamic pressure with volume mode
59. How do you check the plateau pressure (PPlat), on a volume mode?
    a. Inspiratory pause
    b. Expiratory pause
    c. Same as the peak inspiratory pressure (PIP)

   d. Ask the respiratory therapist
60. How do you check the plateau pressure (PPlat), on a pressure mode?
   a. Inspiratory pause
   b. Expiratory pause
   c. Same as the peak inspiratory pressure (PIP)
   d. Ask the respiratory therapist
61. What does it mean when there is increased peak inspiratory pressure (PIP) and increased plateau pressure (PPlat)?
   a. High resistance in the circuit or patient
   b. Poor pulmonary perfusion
   c. Need to change the ventilator mode
   d. Decreased compliance
62. Which is not a cause of increased peak inspiratory pressure (PIP) and increased plateau pressure (PPlat)?
   a. Pulmonary edema
   b. Bronchospasms
   c. Pneumothorax
   d. Abdominal compartment syndrome
   e. ARDS
63. What does it mean when there is increased peak inspiratory pressure (PIP) and low plateau pressure (PPlat)?
   a. High resistance in the circuit or patient
   b. Decreased compliance
   c. Poor pulmonary perfusion
   d. Need to change the ventilator mode
64. Which is not a cause of increased peak inspiratory pressure (PIP) and low plateau pressure (PPlat)?
   a. Endotracheal tube occlusion
   b. Mucous plugging
   c. Pulmonary embolism
   d. Bronchospasms
65. Which mode of ventilation allows more control over the minute ventilation?
   a. Volume breath
   b. Pressure breath
66. What happens as compliance decreases in a volume breath?
   a. Less oxygen delivery and hypoxia
   b. Higher peak inspiratory pressures (PIP) leading to barotrauma
   c. Higher FiO_2 and oxygen toxicity
   d. Decrease in the minute ventilation leading to decreased PEEP and atelectasis
67. What is the normal flow pattern of a volume breath?
   a. Constant
   b. Accelerating
   c. Decelerating
   d. Variable
68. What the flow pattern of a pressure delivered breath?
   a. Constant
   b. Accelerating
   c. Decelerating
   d. Variable
69. How is the peak inspiratory pressure (PIP) and the mean airway pressure of a pressure breath in comparison to a volume breath?
   a. ↑ peak airway pressure + ↓ mean airway pressure
   b. ↑ peak airway pressure + ↑ mean airway pressure
   c. ↓ peak airway pressure + ↑ mean airway pressure
   d. ↓ peak airway pressure + ↓ mean airway pressure
70. What is the main disadvantage of a pressure delivered breath?

a. Not as well known to clinicians
b. No control over minute ventilation
c. Constantly pay attention to pressures to make sure adequate tidal volume
d. All of the above

Manuel with Blanks

Goals of Mechanical Ventilation 0055

1. Maximize patient _____ (MV settings, sedation)
2. _____ work of breathing/ allow spontaneous breathing
   - × One of the main reasons for mechanical ventilation is your patient was having excessive work of breathing and they were either in respiratory failure or on the verge of respiratory failure.
   - × Optimal type of breath is spontaneous breath
3. Provide _____ (not perfect) gas exchange (oxygenation and ventilation)
   - × Clearly define oxygen saturation goals
   - × Clearly define CO_2 goals
     - Example: A patient with a traumatic brain injury would need a normal CO_2 goal because a high CO_2 would increase cerebral blood flow and thereby increase intracranial pressure.
4. Minimize toxicity
   - × Barotrauma- overdistension
   - × Volutrauma- high volumes
   - × Atelectotrauma- opening and closing alveoli
   - × O_2 toxicity- >60% (even for short periods of time)
   - × Adverse effects on the cardiovascular system
5. This is a supportive therapy to allow time for other interventions to treat the cause of respiratory failure

Basic Review: Respiratory Physiology 0511

Inhalation

_____ (FRC): Volume of gas in the lungs at end expiration, but prior to inhalation; a state of no gas exchange

Natural tendency is for the lungs to want to _____ due to the natural elastic forces of the lung

Natural tendency of the chest wall to want to _____

- × Active process by diaphragmatic contraction into the abdomen and the rib cage to move outwards
- × _____ intra-thoracic volume
- × _____ intra-thoracic pressure
- × _____ Pressure gradient between atmosphere and intra-thoracic space

Exhalation

- × _____ process = Diaphragm relax
- × Lung recoils
- × _____ intra-thoracic pressure
- × Creates a pressure gradient (alveolar pressure exceeds atmospheric pressure) and gas flow proceeds out of the lungs

Active process: _____ physiology (example: COPD and asthma) causes it to become active

Positive Pressure Ventilation 0655

- × Spontaneous breathing occurs via a _____ pressure circuit (pulled into the lungs)
- × Mechanical ventilation is a complete reversal of normal physiological breathing and occurs via a _____ pressure system (pushed into the lungs)
- × Air flow into lungs is now the result of a machine (ventilator) pushing or forcing air into the lungs

Oxygenation 0748

Diffusion: oxygen moves down the concentration gradient, down the alveoli and into the capillaries

1. _____ – first way to improve oxygenation
2. _____- second way to improve oxygenation (optimal PEEP)
    a. _____: average pressure your lung is being exposed to during mechanical ventilation- both inspiration and expiration
    b. I:E ratio (inspiration to expiration) – lungs stay in expiration twice as long as inspiration
3. _____: can increase oxygenation, but is usually used for refractory hypoxemia
    a. Increases the mean airway pressure -> improved oxygenation
    b. Allows air re-distribution from highly compliant alveoli to less compliant alveoli
    c. Maintaining a larger surface area at end inspiration and allowing more time for air to diffuse across the alveoli and into the capillaries

Ventilation= removal of CO_2 from the body

Simple diffusion + Convection- CO_2 builds up in the capillaries

_____= Respiratory Rate x Tidal Volume

1. Respiratory Rate
2. Tidal Volume
    - × _____ventilation-in theory people should breathe in gas that is void of CO_2; however, the CO_2 that remains in the airway mixes w/ the inhaled gas=> increased dead space ventilation with worsening respiratory distress/ decreased ventilation => decreased gradient for CO_2 to diffuse out of the capillaries
    - × Inhalation of CO_2 "void" gas allows CO_2 to diffuse out of the capillaries and into the alveoli, which is removed with exhalation; if we breathe in a larger _____, this will extend the alveoli, which increases the transfer of CO_2 or breath faster by increasing the _____
    - × Tidal volume- limit to how much can deliver, goal _____ ml/kg of predicted body weight
        - If give too much-> volutrauma
3. Expiratory Time
    - × Obstructive Lung Disease (e.g. COPD and Asthma)- want to decrease the respiratory rate to allow more time in exhalation because if the expiratory time is too short then the CO_2 is trapped

Complications of Mechanical Ventilation 1352

Ventilator Associated Lung Injury (VILI)

1. _____: injury to alveoli, caused by excessive pressure from the ventilator
    - × Plateau pressure, aka the pressure that the alveoli see-> this is seen by doing an inspiratory pause

- × limit the plateau pressure to < _____mmHg

2. _____: over distension of the alveoli from excessive tidal volume (Vt)
   - × Limit the tidal volumes to _____ml/ kg of predicted body weight
3. _____: damage which may occur when repetitively opening and closing lung units (a type of sheering stress to the lung)
   - × Importance of Optimal PEEP
   - × End Inspiration: well expanded and optimal to provide adequate gas exchange
   - × Expiration with inadequate PEEP: the alveoli collapse and develop atelectasis; a lot more pressure will be needed to expand the alveoli from the collapsed state to the volume at end expiratory-> _____
   - × Expiration with adequate PEEP: less pressure is needed to re-expand the alveoli at end expiration-> have not allowed the alveoli to close and become atelectatic
   - × _____- difference between the plateau pressure and the PEEP
4. _____: lung injury resulting from inflammation mediators (precipitated by VILI) this can be caused by barotrauma, volutrauma, or atelectotrauma
5. _____: lung injury due to O_2 induced production of free radicals
   - × Using a goal of <100% saturation allows weaning of FiO_2 and decrease risk of oxygen toxicity; goal of <_____% FiO_2

Hemodynamic Consequences 1850

Cardiac output is determined by a _____, or high-pressure system leaving the left ventricle and returning to the heart via a low-pressure system via the right atrium

Spontaneous breathing is a negative pressure, which causes a _____ pressure system in the thorax and _____ resistance of blood flow to return to the right atrium and assist in allowing adequate venous return and pre-load

Positive pressure ventilation leads to _____ intrathoracic pressure leads to _____ right atrial pressures and impede venous return

The decrease in venous return is amplified when a patient has _____. This can lead to decrease in cardiac output and _____ = need a fluid bolus to restore intravascular volume and improve preload.

- × Right Atrium-
  - Positive pressure is delivered-> increased positive intrathoracic pressure and this pressure is transmitted to the _____ right atrium -> increase in pressure in the right atrium -> _____ of venous return and _____ preload
  - This is less of a problem in patients that are not intravascularly volume depleted
- × Right Ventricle-
  - _____ intrathoracic pressure leads to _____ right ventricular afterload, which is normally well tolerated, except in patients with _____ (e.g. long standing pulmonary hypertension or acutely from a massive PE)=> RV collapse and failure with possible cardiac arrest
- × Left Ventricle-
  - _____ intrathoracic pressure leads to a _____ pressure gradient between the ventricle and the intrathoracic space will _____ LV afterload => _____ stroke volume and cardiac output
- × Heart failure-

- beneficial by assisting the LV and allowing more cardiac output

Modes 0130

Terminology

Breath Type: 3 types of breaths that can be delivered

1. controlled
2. assisted
3. spontaneous

Breath Delivery: How much volume of gas is delivered to the patient

× _____
× _____

Mode: How breath types are combined together; examples: CMV, ACV, IMV, PS

Mechanical Ventilator Breaths and Pull-ups 0256

Imagine you have never heard or attempted a pull up for this analogy

1. _____ Breath
   × No work (You just hang on the bar while the trainer pushes you up the bar a few times)
   × Ventilator does _____; the frequency/ rate of the breaths and the amount of gas delivered is fully dependent on the ventilator
     - Example: CMV (controlled mandatory ventilation)- ventilator determines the rate and the amount of gas
2. _____ Breath
   × Start Work (You make the effort to start doing the pull-up, but the trainer knows you are not strong enough- they then do everything, one they see your effort)
   × Ventilator _____: The patient will trigger a breath, and once that is sensed by the ventilator- the ventilator does all the work. The patient can determine the respiratory rate
     - Example: ACV (Assist control ventilation)- combination of a controlled breath and assisted breath
3. _____ Breath (also called spontaneous breath)
   × Able to do some or most of the work (You are now much stronger start the pull up. The trainer will only give you some support to complete the pullup. The weaker you are, the more support the trainer has to give you, and the inverse is true- the stronger you are, the less support the trainer has to give you)
   × Ventilator _____ (i.e. pressure support). The patient starts the process of taking a breath, and only gets some support from the ventilator. However, most of the work is done by the patient.
     - Example: pressure support will assist or augment their efforts
     - Example: SIMV (synchronized intermittent mandatory ventilation)- Ventilator combines a controlled or assisted breath and combine with a spontaneous breath

Breath Delivery 0628

Volume breath: a preset amount of _____ is delivered to the patient

× The amount of pressure the ventilator needed to deliver this volume of gas is unknown; this depends on the patient's _____

- The lower the compliance, or the stiffer the lung, the _____ pressure it will take to deliver the volume
- As the compliance increases, or the lung gets more stretchy, the _____ pressure it will take to deliver the same volume of gas

Pressure breath: a preset _____ will deliver the gas

- The amount of volume that will be delivered to the patient is unknown, as this depends on the patient's _____
- The lower the compliance means that _____ volume will be delivered to a patient at a given pressure
- To give a larger volume of gas, in a patient with low compliance, a _____ preset pressure would need to be given
- As the compliance increases, or the lung gets more stretchy, the _____ volume will be delivered with the same amount of pressure

Compliance= change in _____ / change in _____

- If you are on a volume mode, pay close attention to the pressure
  - ↑ _____ = ↓ compliance
  - ↓ _____ = ↑ compliance
- If you are on a pressure mode, pay close attention to the volume
  - ↑_____ = ↑ compliance
  - ↓ _____ = ↓ compliance

Peak inspiratory pressure (PIP)

- Normally should be in the teens, < _____ cm of water pressure
- _____ needed to fully inflate the lung and overcome the resistive and elastic forces of the lungs

Plateau Pressure (PPlat):

- pressure that _____ (_____ pause)
- _____ since there is no air movement
- PIP > _____ cm of water pressure, need to check the plateau pressure

Elevated PIP and elevated PPlat= indicate _____ compliance

Lung itself= pulmonary edema, pneumonia, ARDS, or pulmonary contusion

Chest wall/ thorax= pneumothorax, pleural effusion, large circumferential burns w. eschar formations

Abdomen= massive ascites or abdominal compartment syndrome

Elevated PIP and low PPlat= _____ in the circuit or patient

Examples: patient biting ET tube, kinked ET tube, increased secretions, mucous plugging, COPD or Asthma

Pressure Vs Volume 1236

Advantage of Volume delivered breath

- More control over the _____ = tidal volume X respiratory rate
- More clinicians are familiar with volume breaths

Disadvantage of Volume delivered breath

- As compliance decreases there will be need for higher _____, which can lead to _____
- Flow pattern is delivered, constant flow wave form, can lead to patient _____ and there by increased _____ = square breath on the ventilation
- Note: we breath by a _____ inspiratory wave form

Advantage of Pressure delivered breath

- Uses a _____ waveform, which is physiological and can be more comfortable for the patient
- _____ peak inspiratory pressure compared to a volume breath
- Improves oxygenation due to a higher _____ compared to volume breath

Disadvantages of Pressure delivered breath

- No direct control over _____; have to make sure the patient is getting an adequate _____ for the pressure
- Less familiar to clinicians
- Have to constantly pay attention to the pressures, since _____ is changing a lot, to get an adequate or appropriate _____

Reinforcement Game

Students:

1. Write three thing you have learned from the video
2. Turn to your neighbor and discuss these three things
3. Turn in the paper before you leave

Note: help with attendance

Name: 1) 2) 3)	Name: 1) 2) 3)
Name: 1) 2) 3)	Name: 1) 2) 3)
Name: 1) 2) 3)	Name: 1) 2) 3)
Name: 1) 2) 3)	Name: 1) 2) 3)

Post Test Questions

1. Which of the following is not the main goal of mechanical ventilation in the ICU?
    a. Optimize patient comfort
    b. Optimize exchange of carbon dioxide and oxygen
    c. Get them through surgery with less discomfort
    d. Decrease work of breathing
2. How is the peak inspiratory pressure (PIP) and the mean airway pressure of a pressure breath in comparison to a volume breath?
    a. ↑ peak airway pressure + ↓ mean airway pressure
    b. ↑ peak airway pressure + ↑ mean airway pressure
    c. ↓ peak airway pressure + ↑ mean airway pressure
    d. ↓ peak airway pressure + ↓ mean airway pressure
3. What is the optimal type of breath?
    a. Spontaneous
    b. Controlled
    c. Assisted
    d. None of the above
4. What happens as compliance decreases in a volume breath?
    a. Less oxygen delivery and hypoxia
    b. Higher peak inspiratory pressures (PIP) leading to barotrauma
    c. Higher FiO_2 and oxygen toxicity
    d. Decrease in the minute ventilation leading to decreased PEEP and atelectasis
5. When giving a pressure breath, what is the relationship between compliance and volume?
    a. Lower compliance, the less volume delivered
    b. Lower compliance, the more volume delivered
    c. Higher volume, the higher the compliance needed
    d. Lower volume, the higher the compliance needed
6. Which of the following is not a way to improve oxygenation?
    a. FiO_2
    b. PEEP
    c. Inspiratory time
    d. Respiratory rate
7. What should the carbon dioxide goal be with traumatic brain injury?
    a. High to allow increased cerebral blood flow
    b. High to prevent increased cerebral blood flow
    c. Normal to prevent increased cerebral blood flow
    d. Normal to allow increased cerebral blood flow
8. Which mode of ventilation allows more control over the minute ventilation?
    a. Volume breath
    b. Pressure breath
9. What is the injury from over distension of the alveoli from excessive tidal volume called?
    a. Barotrauma
    b. Volumtrauma
    c. Atelectotrauma
    d. Biotrauma
    e. Oxygen toxicity
10. What is meant by a static pressure vs dynamic pressure?
    a. Dynamic is seen during an inspiratory hold, whereas static is the same as the Peak inspiratory pressure (PIP)
    b. Static has no air movement, dynamic pressure has air movement
    c. Same thing: static pressure is used with volume mode and dynamic pressure with pressure mode
    d. Same thing: static pressure is used with pressure mode and dynamic pressure with volume mode
11. Is inhalation an active or passive process?

a. Active
b. Passive

12. Which of the following is not a toxicity with mechanical intubation?
    a. Hypercarbia
    b. Barotrauma
    c. Volutrauma
    d. Atelactotrauma
    e. Oxygen toxicity
13. What happens with inadequate PEEP?
    a. Alveoli collapse and develop atelectasis
    b. Poor compliance
    c. Inadequate minute ventilation
14. When giving a volume breath, what is the relationship between compliance and pressure?
    a. Higher the pressure, higher the compliance needed
    b. Lower the compliance, higher the pressure needed
    c. Lower the pressure, lower the compliance needed
    d. Higher the compliance, higher the pressure needed
15. What percent of oxygen can lead to oxygen toxicity (even if only a short period of time)?
    a. >50 %
    b. >60%
    c. >70%
    d. >80%
16. What is the volume of gas in the lungs at the end of expiration, but prior to inhalation?
    a. Inspiratory Capacity
    b. Expiratory Capacity
    c. Vital Capacity
    d. Tidal Volume
    e. Functional Residual Capacity
17. What is the normal peak inspiratory pressure (PIP)?
    a. Variable depending on body habitus
    b. >20 cm of water pressure
    c. <10 cm of water pressure
    d. <20 cm of water pressure
18. What happens to the intrathoracic pressure/ volume when you inhale?
    a. ↑ intra-thoracic pressure: ↑intra-thoracic volume
    b. ↑ intra-thoracic pressure: ↓intra-thoracic volume
    c. ↓ intra-thoracic pressure: ↑intra-thoracic volume
    d. ↓ intra-thoracic pressure: ↓intra-thoracic volume
19. Is exhalation an active or passive process?
    a. Active
    b. Passive
20. What is synchronized intermittent mandatory ventilation (SIMV)?
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
21. Describe the type of breath when the patient starts the process (aka triggers a breath), but the ventilator takes over.
    a. Controlled
    b. Assisted
    c. Manuel
    d. Supported
22. What is the lung injury due to oxygen production of free radicals called?
    a. Barotrauma
    b. Volumtrauma

c. Atelectotrauma
d. Biotrauma
e. Oxygen toxicity

23. What happens to the intrathoracic pressure/volume when you exhale?
    a. ↑ intra-thoracic pressure: ↑intra-thoracic volume
    b. ↑ intra-thoracic pressure: ↓intra-thoracic volume
    c. ↓ intra-thoracic pressure: ↑intra-thoracic volume
    d. ↓ intra-thoracic pressure: ↓intra-thoracic volume
24. When does exhalation become an active process?
    a. With restrictive lung disease
    b. After you run a mile
    c. With obstructive lung disease
25. Mechanical ventilation works by_____?
    a. Positive pressure- pushing air into the lungs
    b. Negative pressure- pulling out the chest wall
26. What is mean airway pressure?
    a. Average pressure that alveoli are exposed to during inspiration
    b. Average pressure that the lungs are exposed to during expiration
    c. Average pressure the lung is exposed to during mechanical ventilation
27. Which is a dynamic pressure needed to fully inflate the lungs and overcome the resistive forces and elastic forces of the lungs?
    a. Peak Inspiratory Pressure (PIP)
    b. Positive end expiratory pressure (PEEP)
    c. Plateau pressure (PPlat)
    d. End Expiratory Pressure
28. What is the equation for minute ventilation?
    a. Respiratory Rate X PEEP
    b. Respiratory Rate X Tidal Volume
    c. Tidal Volume X Expiratory Time
    d. Expiratory Time X Respiratory Rate
29. What is removal of carbon dioxide from the body called?
    a. Hypercarbia
    b. Hypocarbia
    c. Ventilation
    d. Tidal Volume
30. Is positive pressure good or bad with heart failure? Why?
    a. Bad; increases afterload and deceases cardiac output
    b. Good; decreases preload and increases cardiac output
    c. Bad; decreases preload and decreases cardiac output
    d. Good; decreases the LV afterload and allows more cardiac output
    e. Depends on the type an etiology of heart failure
31. What happens to blood return with spontaneous breathing?
    a. Positive intrathoracic pressure that causes less resistance and assists in venous return
    b. Negative intrathoracic pressure that causes increased resistance and impedes in adequate venous return
    c. Positive intrathoracic pressure that causes increased resistance and impedes venous return
    d. Negative intrathoracic pressure that causes less resistance and assists in venous return
32. What the flow pattern of a pressure delivered breath?
    a. Constant
    b. Accelerating
    c. Decelerating
    d. Variable
33. How does increasing the tidal volume allow more CO2 removal?
    a. Allows more surface area for the transfer of CO2
    b. Increases the mean airway pressure

c. Allows the alveoli to remain open longer for gas exchange
d. Improves compliance

34. Since tidal volume is limited, what else can we adjust to improve minute ventilation?
    a. Inspiratory time
    b. FiO_2
    c. Respiratory Rate
    d. Expiratory time
35. What is a static pressure that the alveoli see?
    a. Positive end expiratory pressure (PEEP)
    b. Driving pressure
    c. Plateau pressure (PPlat)
    d. Peak Inspiratory Pressure (PIP)
36. Why do patients with obstructive lung disease need a shorter respiratory rate?
    a. Gives the patients time to rest
    b. Shorter respiratory rate allows a longer expiratory time as they have trouble with air removal
    c. Shorter respiratory rate allows for less positive end expiratory pressure
    d. Shorter respiratory rate allows for longer inspiratory time to improve oxygenation
37. What is dead space ventilation?
    a. Carbon dioxide in the unventilated alveoli
    b. Carbon dioxide delivered to the patient if the patient isn't on 100% oxygen
    c. Carbon dioxide that is unable to diffuse out of the capillaries
    d. Carbon dioxide still in the airway at expiration
38. What happens to blood return to the right atrium with positive pressure ventilation?
    a. Positive intrathoracic pressure that causes less resistance and assists in venous return
    b. Negative intrathoracic pressure that causes increased resistance and impedes in adequate venous return
    c. Positive intrathoracic pressure that causes increased resistance and impedes venous return
    d. Negative intrathoracic pressure that causes less resistance and assists in venous return
39. What is the injury to the alveoli caused by excessive pressure from the ventilator called?
    a. Barotrauma
    b. Volumtrauma
    c. Atelectotrauma
    d. Biotrauma
    e. Oxygen toxicity
40. What is the normal I:E ratio?
    a. Inspiration is longer than expiration
    b. Expiration is longer than inspiration
    c. Inspiration and expiration are equal
41. What is injury from repetitively opening and closing lung units (a type of sheering stress to the lung) called?
    a. Barotrauma
    b. Volumtrauma
    c. Atelectotrauma
    d. Biotrauma
    e. Oxygen toxicity
    f. Higher oxygen requirements leading to oxygen toxicity
42. What happens with adequate PEEP?
    a. Better driving pressure
    b. Less pressure is needed to re-expand the alveoli at the end of expiration
    c. Improved minute ventilation
    d. Lower oxygen requirements thus decreasing risk of barotrauma
43. What is the difference between the plateau pressure (PPlat) and the positive end expiratory pressure (PEEP)?
    a. Driving pressure

b. Static pressure
c. Dynamic Pressure
d. Compliance

44. How can you help improve venous return in a patient on positive pressure ventilation?
    a. If the patient has decreased intravascular volume, a fluid bolus will help
    b. Higher levels of positive end expiratory pressure (PEEP)
    c. Increase the volume/pressure breath (depends on the mode)
    d. Trial of bronchodilators to decrease afterload
45. What happens to the right ventricle with positive pressure ventilation?
    a. Decreased right ventricular afterload
    b. Increased right ventricular preload
    c. No significant changes to the right ventricle
    d. Increased right ventricular afterload
46. Will all patients have perfect carbon dioxide and oxygen levels?
    a. Yes
    b. No
47. What is the lung injury resulting from inflammatory mediators called?
    a. Barotrauma
    b. Volumtrauma
    c. Atelectotrauma
    d. Biotrauma
    e. Oxygen toxicity
48. What happens if you intubate a patient with RV failure?
    a. Nothing with rapid sequence intubation technique
    b. Improved pre-load to the RV
    c. RV collapse and cardiac arrest
    d. Increased ejection fraction of the right ventricle
49. What happens to the left ventricle with positive pressure ventilation?
    a. Increased stroke volume and increased cardiac output
    b. Decreased stroke volume and decreased cardiac output
    c. Increased heart rate and increased cardiac output
    d. Decreased heart rate and decreased cardiac output
50. Which of the following is not a type of breath that can be delivered by a ventilator?
    a. Controlled
    b. Assisted
    c. Manuel
    d. Spontaneous
51. What are the two types of breath delivery?
    a. FiO_2, PEEP
    b. Volume, pressure
    c. Flow, volume
    d. Respiratory rate and tidal volume
52. What type of breath requires no work by the patient, as the frequency/rate of the breath and the amount of gas delivered is fully dependent on the ventilator?
    a. Controlled
    b. Assisted
    c. Manuel
    d. Supported
53. How do you check the plateau pressure (PPlat), on a pressure mode?
    a. Inspiratory pause
    b. Expiratory pause
    c. Same as the peak inspiratory pressure (PIP)
    d. Ask the respiratory therapist
54. With what type of breath does the patient do most/all of the work, and the ventilator gives only minimal assistance, if needed?
    a. Controlled

b. Assisted
c. Manuel
d. Supported

55. What is controlled mandatory ventilation (CMV)?
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
56. What is pressure support?
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
57. What is assist controlled ventilation (ACV)?
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
58. In which mode of ventilation is a pre-set amount of gas delivered to the patient?
    a. Volume breath
    b. Pressure Breath
    c. Both
    d. Neither
59. When giving a volume breath, at what pressure will the gas be delivered?
    a. Depends on compliance
    b. 6-8 ml / kg of ideal body weight
    c. Depends on the respiratory rate
    d. Depends on the flow and inspiratory time
60. In which mode of ventilation will a pre-set pressure deliver gas to the patient Volume breath
    a. Pressure Breath
    b. Both
    c. Neither
61. What are ways to maximize patient comfort on the ventilator?
    a. Optimize ventilation settings
    b. Sedation
    c. Paralytics
    d. All of the above
62. When giving a pressure breath, how much volume of gas will be delivered to a patient?
    a. Depends on compliance
    b. 6-8 ml / kg of ideal body weight
    c. Depends on the respiratory rate
    d. Depends on the flow and inspiratory time
63. How do you check the plateau pressure (PPlat), on a volume mode?
    a. Inspiratory pause
    b. Expiratory pause
    c. Same as the peak inspiratory pressure (PIP)
    d. Ask the respiratory therapist
64. What does it mean when there is increased peak inspiratory pressure (PIP) and increased plateau pressure (PPlat)?
    a. High resistance in the circuit or patient
    b. Poor pulmonary perfusion
    c. Need to change the ventilator mode
    d. Decreased compliance

65. Which is not a cause of increased peak inspiratory pressure (PIP) and increased plateau pressure (PPlat)?
    a. Pulmonary edema
    b. Bronchospasms
    c. Pneumothorax
    d. Abdominal compartment syndrome
    e. ARDS
66. How does increasing the inspiratory time lead to improved oxygenation?
    a. It increases mean airway pressure
    b. It decreases expiration time
    c. It improves PEEP
    d. It increases the tidal volume
67. What does it mean when there is increased peak inspiratory pressure (PIP) and low plateau pressure (PPlat)?
    a. High resistance in the circuit or patient
    b. Decreased compliance
    c. Poor pulmonary perfusion
    d. Need to change the ventilator mode
68. Which is not a cause of increased peak inspiratory pressure (PIP) and low plateau pressure (PPlat)?
    a. Endotracheal tube occlusion
    b. Mucous plugging
    c. Pulmonary embolism
    d. Bronchospasms
69. What is the normal flow pattern of a volume breath?
    a. Constant
    b. Accelerating
    c. Decelerating
    d. Variable
70. What is the main disadvantage of a pressure delivered breath?
    a. Not as well known to clinicians
    b. No control over minute ventilation
    c. Constantly pay attention to pressures to make sure adequate tidal volume
    d. All of the above

Pre- Test Questions and Answers

1. Which of the following is not the main goal of mechanical ventilation in the ICU? I-0055
   a. Optimize patient comfort
   b. Optimize exchange of carbon dioxide and oxygen
   c. Get them through surgery with less discomfort
   d. Decrease work of breathing
2. What are ways to maximize patient comfort on the ventilator? I-0110
   a. Optimize ventilation settings
   b. Sedation
   c. Paralytics
   d. All of the above
3. What is the optimal type of breath? I-0134
   a. Spontaneous
   b. Controlled
   c. Assisted
   d. None of the above
4. Will all patients have perfect carbon dioxide and oxygen levels? I-0230
   a. Yes
   b. No
5. What should the carbon dioxide goal be with traumatic brain injury? I--0253
   a. High to allow increased cerebral blood flow
   b. High to prevent increased cerebral blood flow
   c. Normal to prevent increased cerebral blood flow
   d. Normal to allow increased cerebral blood flow
6. Which of the following is not a toxicity with mechanical intubation? I-0330
   a. Hypercarbia
   b. Barotrauma
   c. Volutrauma
   d. Atelactotrauma
   e. Oxygen toxicity
7. What percent of oxygen can lead to oxygen toxicity (even if only a short period of time)? I-0330
   a. >50 %
   b. >60%
   c. >70%
   d. >80%
8. What is the volume of gas in the lungs at the end of expiration, but prior to inhalation? I-0515
   a. Inspiratory Capacity
   b. Expiratory Capacity
   c. Vital Capacity
   d. Tidal Volume
   e. Functional Residual Capacity
9. Is inhalation an active or passive process? I-0515
   a. Active
   b. Passive
10. What happens to the intrathoracic pressure/ volume when you inhale? I-0545
    a. ↑ intra-thoracic pressure: ↑intra-thoracic volume
    b. ↑ intra-thoracic pressure: ↓intra-thoracic volume
    c. ↓ intra-thoracic pressure: ↑intra-thoracic volume
    d. ↓ intra-thoracic pressure: ↓intra-thoracic volume
11. Is exhalation an active or passive process? I-0620
    a. Active
    b. Passive
12. What happens to the intrathoracic pressure/volume when you exhale? I-0620
    a. ↑ intra-thoracic pressure: ↑intra-thoracic volume
    b. ↑ intra-thoracic pressure: ↓intra-thoracic volume

c. ↓ intra-thoracic pressure: ↑intra-thoracic volume
d. ↓ intra-thoracic pressure: ↓intra-thoracic volume

13. When does exhalation become an active process? I-0620
    a. With restrictive lung disease
    b. After you run a mile
    c. With obstructive lung disease
14. Mechanical ventilation works by_____? I-0655
    a. Positive pressure- pushing air into the lungs
    b. Negative pressure- pulling out the chest wall
15. Which of the following is not a way to improve oxygenation? I-0748
    a. FiO_2
    b. PEEP
    c. Inspiratory time
    d. Respiratory rate
16. What is mean airway pressure? I-0826
    a. Average pressure that alveoli are exposed to during inspiration
    b. Average pressure that the lungs are exposed to during expiration
    c. Average pressure the lung is exposed to during mechanical ventilation
17. What is the normal I:E ratio? I-0844
    a. Inspiration is longer than expiration
    b. Expiration is longer than inspiration
    c. Inspiration and expiration are equal
18. How does increasing the inspiratory time lead to improved oxygenation? I-0910
    a. It increases mean airway pressure
    b. It decreases expiration time
    c. It improves PEEP
    d. It increases the tidal volume
19. What is removal of carbon dioxide from the body called? I-1002
    a. Hypercarbia
    b. Hypocarbia
    c. Ventilation
    d. Tidal Volume
20. What is the equation for minute ventilation? I-1040
    a. Respiratory Rate X PEEP
    b. Respiratory Rate X Tidal Volume
    c. Tidal Volume X Expiratory Time
    d. Expiratory Time X Respiratory Rate
21. What is dead space ventilation? I-1058
    a. Carbon dioxide in the unventilated alveoli
    b. Carbon dioxide delivered to the patient if the patient isn't on 100% oxygen
    c. Carbon dioxide that is unable to diffuse out of the capillaries
    d. Carbon dioxide still in the airway at expiration
22. How does increasing the tidal volume allow more CO2 removal? I-1138
    a. Allows more surface area for the transfer of CO2
    b. Increases the mean airway pressure
    c. Allows the alveoli to remain open longer for gas exchange
    d. Improves compliance
23. Since tidal volume is limited, what else can we adjust to improve minute ventilation? I-1138
    a. Inspiratory time
    b. FiO_2
    c. Respiratory Rate
    d. Expiratory time
24. Why do patients with obstructive lung disease need a shorter respiratory rate? I-1245
    a. Gives the patients time to rest
    b. Shorter respiratory rate allows a longer expiratory time as they have trouble with air removal

c. Shorter respiratory rate allows for less positive end expiratory pressure
d. Shorter respiratory rate allows for longer inspiratory time to improve oxygenation

25. What is the injury to the alveoli caused by excessive pressure from the ventilator called? I-1406
    a. Barotrauma
    b. Volumtrauma
    c. Atelectotrauma
    d. Biotrauma
    e. Oxygen toxicity
26. What is the injury from over distension of the alveoli from excessive tidal volume called? I-1413
    a. Barotrauma
    b. Volumtrauma
    c. Atelectotrauma
    d. Biotrauma
    e. Oxygen toxicity
27. What is the injury from repetitively opening and closing lung units (a type of sheering stress to the lung) called? I-1416
    a. Barotrauma
    b. Volumtrauma
    c. Atelectotrauma
    d. Biotrauma
    e. Oxygen toxicity
28. What is the lung injury resulting from inflammatory mediators called? I-1438
    a. Barotrauma
    b. Volumtrauma
    c. Atelectotrauma
    d. Biotrauma
    e. Oxygen toxicity
29. What is the lung injury due to oxygen production of free radicals called? I-1509
    a. Barotrauma
    b. Volumtrauma
    c. Atelectotrauma
    d. Biotrauma
    e. Oxygen toxicity
30. What happens with inadequate PEEP? I-1729
    a. Alveoli collapse and develop atelectasis
    b. Poor compliance
    c. Inadequate minute ventilation
    d. Higher oxygen requirements leading to oxygen toxicity
31. What happens with adequate PEEP? I-1803
    a. Better driving pressure
    b. Less pressure is needed to re-expand the alveoli at the end of expiration
    c. Improved minute ventilation
    d. Lower oxygen requirements thus decreasing risk of barotrauma
32. What is the difference between the plateau pressure (PPlat) and the positive end expiratory pressure (PEEP)? I-1825
    a. Driving pressure
    b. Static pressure
    c. Dynamic Pressure
    d. Compliance
33. What happens to blood return with spontaneous breathing? I-1911
    a. Positive intrathoracic pressure that causes less resistance and assists in venous return
    b. Negative intrathoracic pressure that causes increased resistance and impedes in adequate venous return
    c. Positive intrathoracic pressure that causes increased resistance and impedes venous return
    d. Negative intrathoracic pressure that causes less resistance and assists in venous return

34. What happens to blood return to the right atrium with positive pressure ventilation? I-1932, 2010
    a. Positive intrathoracic pressure that causes less resistance and assists in venous return
    b. Negative intrathoracic pressure that causes increased resistance and impedes in adequate venous return
    c. Positive intrathoracic pressure that causes increased resistance and impedes venous return
    d. Negative intrathoracic pressure that causes less resistance and assists in venous return
35. How can you help improve venous return in a patient on positive pressure ventilation? I-1944
    a. If the patient has decreased intravascular volume, a fluid bolus will help
    b. Higher levels of positive end expiratory pressure (PEEP)
    c. Increase the volume/pressure breath (depends on the mode)
    d. Trial of bronchodilators to decrease afterload
36. What happens to the right ventricle with positive pressure ventilation? I-2048
    a. Decreased right ventricular afterload
    b. Increased right ventricular preload
    c. No significant changes to the right ventricle
    d. Increased right ventricular afterload
37. What happens if you intubate a patient with RV failure? I-2048
    a. Nothing with rapid sequence intubation technique
    b. Improved pre-load to the RV
    c. RV collapse and cardiac arrest
    d. Increased ejection fraction of the right ventricle
38. What happens to the left ventricle with positive pressure ventilation? I-2128
    a. Increased stroke volume and increased cardiac output
    b. Decreased stroke volume and decreased cardiac output
    c. Increased heart rate and increased cardiac output
    d. Decreased heart rate and decreased cardiac output
39. Is positive pressure good or bad with heart failure? Why? I-2150
    a. Bad; increases afterload and deceases cardiac output
    b. Good; decreases preload and increases cardiac output
    c. Bad; decreases preload and decreases cardiac output
    d. Good; decreases the LV afterload and allows more cardiac output
    e. Depends on the type an etiology of heart failure

40. Which of the following is not a type of breath that can be delivered by a ventilator? II-0216
    a. Controlled
    b. Assisted
    c. Manuel
    d. Spontaneous
41. What are the two types of breath delivery? II-0228
    a. FiO_2, PEEP
    b. Volume, pressure
    c. Flow, volume
    d. Respiratory rate and tidal volume
42. What type of breath requires no work by the patient, as the frequency/rate of the breath and the amount of gas delivered is fully dependent on the ventilator? II-0318
    a. Controlled
    b. Assisted
    c. Manuel
    d. Supported
43. Describe the type of breath when the patient starts the process (aka triggers a breath), but the ventilator takes over. II-0401
    a. Controlled
    b. Assisted
    c. Manuel
    d. Supported
44. With what type of breath does the patient do most/all of the work, and the ventilator gives only minimal assistance, if needed? II-0405
    a. Controlled
    b. Assisted
    c. Manuel
    d. Supported
45. What is controlled mandatory ventilation (CMV)? II-0551
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
46. What is pressure support? II-0535
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
47. What is assist controlled ventilation (ACV)? II-0600
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
48. What is synchronized intermittent mandatory ventilation (SIMV)? II-0608
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
49. In which mode of ventilation is a pre-set amount of gas delivered to the patient? II-0632
    a. Volume breath

b. Pressure Breath
c. Both
d. Neither

50. When giving a volume breath, at what pressure will the gas be delivered? II-0650
    a. Depends on compliance
    b. 6-8 ml / kg of ideal body weight
    c. Depends on the respiratory rate
    d. Depends on the flow and inspiratory time
51. When giving a volume breath, what is the relationship between compliance and pressure? II-7010, 0721, 0820
    a. Higher the pressure, higher the compliance needed
    b. Lower the compliance, higher the pressure needed
    c. Lower the pressure, lower the compliance needed
    d. Higher the compliance, higher the pressure needed
52. In which mode of ventilation will a pre-set pressure deliver gas to the patient? II-0730
    a. Volume breath
    b. Pressure Breath
    c. Both
    d. Neither
53. When giving a pressure breath, how much volume of gas will be delivered to a patient? II-0747
    a. Depends on compliance
    b. 6-8 ml / kg of ideal body weight
    c. Depends on the respiratory rate
    d. Depends on the flow and inspiratory time
54. When giving a pressure breath, what is the relationship between compliance and volume? II-0748, 0802, 0810, 0850
    a. Lower compliance, the less volume delivered
    b. Lower compliance, the more volume delivered
    c. Higher volume, the higher the compliance needed
    d. Lower volume, the higher the compliance needed
55. Which is a dynamic pressure needed to fully inflate the lungs and overcome the resistive forces and elastic forces of the lungs? II-0925, 1045
    a. Peak Inspiratory Pressure (PIP)
    b. Positive end expiratory pressure (PEEP)
    c. Plateau pressure (PPlat)
    d. End Expiratory Pressure
56. What is the normal peak inspiratory pressure (PIP)? II-1014
    a. Variable depending on body habitus
    b. >20 cm of water pressure
    c. <10 cm of water pressure
    d. <20 cm of water pressure
57. What is a static pressure that the alveoli see? II-1026
    a. Positive end expiratory pressure (PEEP)
    b. Driving pressure
    c. Plateau pressure (PPlat)
    d. Peak Inspiratory Pressure (PIP)
58. What is meant by a static pressure vs dynamic pressure? II-1026, 1045
    a. Dynamic is seen during an inspiratory hold, whereas static is the same as the Peak inspiratory pressure (PIP)
    b. Static has no air movement, dynamic pressure has air movement
    c. Same thing: static pressure is used with volume mode and dynamic pressure with pressure mode
    d. Same thing: static pressure is used with pressure mode and dynamic pressure with volume mode
59. How do you check the plateau pressure (PPlat), on a volume mode? II-1026
    a. Inspiratory pause

b. Expiratory pause
c. Same as the peak inspiratory pressure (PIP)
d. Ask the respiratory therapist

60. How do you check the plateau pressure (PPlat), on a pressure mode? II-1026
    a. Inspiratory pause
    b. Expiratory pause
    c. Same as the peak inspiratory pressure (PIP)
    d. Ask the respiratory therapist
61. What does it mean when there is increased peak inspiratory pressure (PIP) and increased plateau pressure (PPlat)? II-1106
    a. High resistance in the circuit or patient
    b. Poor pulmonary perfusion
    c. Need to change the ventilator mode
    d. Decreased compliance
62. Which is not a cause of increased peak inspiratory pressure (PIP) and increased plateau pressure (PPlat)? II-1106
    a. Pulmonary edema
    b. Bronchospasms
    c. Pneumothorax
    d. Abdominal compartment syndrome
    e. ARDS
63. What does it mean when there is increased peak inspiratory pressure (PIP) and low plateau pressure (PPlat)? II-1145
    a. High resistance in the circuit or patient
    b. Decreased compliance
    c. Poor pulmonary perfusion
    d. Need to change the ventilator mode
64. Which is not a cause of increased peak inspiratory pressure (PIP) and low plateau pressure (PPlat)? II-1145
    a. Endotracheal tube occlusion
    b. Mucous plugging
    c. Pulmonary embolism
    d. Bronchospasms
65. Which mode of ventilation allows more control over the minute ventilation? II-1257
    a. Volume breath
    b. Pressure breath
66. What happens as compliance decreases in a volume breath? II-1343
    a. Less oxygen delivery and hypoxia
    b. Higher peak inspiratory pressures (PIP) leading to barotrauma
    c. Higher FiO_2 and oxygen toxicity
    d. Decrease in the minute ventilation leading to decreased PEEP and atelectasis
67. What is the normal flow pattern of a volume breath? II-1433
    a. Constant
    b. Accelerating
    c. Decelerating
    d. Variable
68. What the flow pattern of a pressure delivered breath? II-1456
    a. Constant
    b. Accelerating
    c. Decelerating
    d. Variable
69. How is the peak inspiratory pressure (PIP) and the mean airway pressure of a pressure breath in comparison to a volume breath? II-1456
    a. ↑ peak airway pressure + ↓ mean airway pressure
    b. ↑ peak airway pressure + ↑ mean airway pressure
    c. ↓ peak airway pressure + ↑ mean airway pressure

d. ↓ peak airway pressure + ↓ mean airway pressure

70. What is the main disadvantage of a pressure delivered breath? II-1533
    a. Not as well known to clinicians
    b. No control over minute ventilation
    c. Constantly pay attention to pressures to make sure adequate tidal volume
    d. All of the above

Post Test Questions and Answers[1]

1. Which of the following is not the main goal of mechanical ventilation in the ICU? I-0055
    a. Optimize patient comfort
    b. Optimize exchange of carbon dioxide and oxygen
    c. Get them through surgery with less discomfort
    d. Decrease work of breathing
2. How is the peak inspiratory pressure (PIP) and the mean airway pressure of a pressure breath in comparison to a volume breath? II-1456
    a. ↑ peak airway pressure + ↓ mean airway pressure
    b. ↑ peak airway pressure + ↑ mean airway pressure
    c. ↓ peak airway pressure + ↑ mean airway pressure
    d. ↓ peak airway pressure + ↓ mean airway pressure
3. What is the optimal type of breath? I-0134
    a. Spontaneous
    b. Controlled
    c. Assisted
    d. None of the above
4. What happens as compliance decreases in a volume breath? II-1343
    a. Less oxygen delivery and hypoxia
    b. Higher peak inspiratory pressures (PIP) leading to barotrauma
    c. Higher FiO_2 and oxygen toxicity
    d. Decrease in the minute ventilation leading to decreased PEEP and atelectasis
5. When giving a pressure breath, what is the relationship between compliance and volume? II-0748, 0802, 0810, 0850
    a. Lower compliance, the less volume delivered
    b. Lower compliance, the more volume delivered
    c. Higher volume, the higher the compliance needed
    d. Lower volume, the higher the compliance needed
6. Which of the following is not a way to improve oxygenation? I-0748
    a. FiO_2
    b. PEEP
    c. Inspiratory time
    d. Respiratory rate
7. What should the carbon dioxide goal be with traumatic brain injury? I--0253
    a. High to allow increased cerebral blood flow
    b. High to prevent increased cerebral blood flow
    c. Normal to prevent increased cerebral blood flow
    d. Normal to allow increased cerebral blood flow
8. Which mode of ventilation allows more control over the minute ventilation? II-1257
    a. Volume breath
    b. Pressure breath
9. What is the injury from over distension of the alveoli from excessive tidal volume called? I-1413
    a. Barotrauma
    b. Volumtrauma
    c. Atelectotrauma
    d. Biotrauma
    e. Oxygen toxicity
10. What is meant by a static pressure vs dynamic pressure? II-1026, 1045
    a. Dynamic is seen during an inspiratory hold, whereas static is the same as the Peak inspiratory pressure (PIP)
    b. Static has no air movement, dynamic pressure has air movement
    c. Same thing: static pressure is used with volume mode and dynamic pressure with pressure mode

[1]

   d. Same thing: static pressure is used with pressure mode and dynamic pressure with volume mode

11. Is inhalation an active or passive process? I-0515
    a. Active
    b. Passive
12. Which of the following is not a toxicity with mechanical intubation? I-0330
    a. Hypercarbia
    b. Barotrauma
    c. Volutrauma
    d. Atelactotrauma
    e. Oxygen toxicity
13. What happens with inadequate PEEP? I-1729
    a. Alveoli collapse and develop atelectasis
    b. Poor compliance
    c. Inadequate minute ventilation
14. When giving a volume breath, what is the relationship between compliance and pressure? II-7010, 0721, 0820
    a. Higher the pressure, higher the compliance needed
    b. Lower the compliance, higher the pressure needed
    c. Lower the pressure, lower the compliance needed
    d. Higher the compliance, higher the pressure needed
15. What percent of oxygen can lead to oxygen toxicity (even if only a short period of time)? I-0330
    a. >50 %
    b. >60%
    c. >70%
    d. >80%
16. What is the volume of gas in the lungs at the end of expiration, but prior to inhalation? I-0515
    a. Inspiratory Capacity
    b. Expiratory Capacity
    c. Vital Capacity
    d. Tidal Volume
    e. Functional Residual Capacity
17. What is the normal peak inspiratory pressure (PIP)? II-1014
    a. Variable depending on body habitus
    b. >20 cm of water pressure
    c. <10 cm of water pressure
    d. <20 cm of water pressure
18. What happens to the intrathoracic pressure/ volume when you inhale? I-0545
    a. ↑ intra-thoracic pressure: ↑intra-thoracic volume
    b. ↑ intra-thoracic pressure: ↓intra-thoracic volume
    c. ↓ intra-thoracic pressure: ↑intra-thoracic volume
    d. ↓ intra-thoracic pressure: ↓intra-thoracic volume
19. Is exhalation an active or passive process? I-0620
    a. Active
    b. Passive
20. What is synchronized intermittent mandatory ventilation (SIMV)? II-0608
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
21. Describe the type of breath when the patient starts the process (aka triggers a breath), but the ventilator takes over. II-0401
    a. Controlled
    b. Assisted
    c. Manuel

d. Supported

22. What is the lung injury due to oxygen production of free radicals called? I-1509
    a. Barotrauma
    b. Volumtrauma
    c. Atelectotrauma
    d. Biotrauma
    e. Oxygen toxicity
23. What happens to the intrathoracic pressure/volume when you exhale? I-0620
    a. ↑ intra-thoracic pressure: ↑intra-thoracic volume
    b. ↑ intra-thoracic pressure: ↓intra-thoracic volume
    c. ↓ intra-thoracic pressure: ↑intra-thoracic volume
    d. ↓ intra-thoracic pressure: ↓intra-thoracic volume
24. When does exhalation become an active process? I-0620
    a. With restrictive lung disease
    b. After you run a mile
    c. With obstructive lung disease
25. Mechanical ventilation works by_____? I-0655
    a. Positive pressure- pushing air into the lungs
    b. Negative pressure- pulling out the chest wall
26. What is mean airway pressure? I-0826
    a. Average pressure that alveoli are exposed to during inspiration
    b. Average pressure that the lungs are exposed to during expiration
    c. Average pressure the lung is exposed to during mechanical ventilation
27. Which is a dynamic pressure needed to fully inflate the lungs and overcome the resistive forces and elastic forces of the lungs? II-0925, 1045
    a. Peak Inspiratory Pressure (PIP)
    b. Positive end expiratory pressure (PEEP)
    c. Plateau pressure (PPlat)
    d. End Expiratory Pressure
28. What is the equation for minute ventilation? I-1040
    a. Respiratory Rate X PEEP
    b. Respiratory Rate X Tidal Volume
    c. Tidal Volume X Expiratory Time
    d. Expiratory Time X Respiratory Rate
29. What is removal of carbon dioxide from the body called? I-1002
    a. Hypercarbia
    b. Hypocarbia
    c. Ventilation
    d. Tidal Volume
30. Is positive pressure good or bad with heart failure? Why? I-2150
    a. Bad; increases afterload and deceases cardiac output
    b. Good; decreases preload and increases cardiac output
    c. Bad; decreases preload and decreases cardiac output
    d. Good; decreases the LV afterload and allows more cardiac output
    e. Depends on the type an etiology of heart failure
31. What happens to blood return with spontaneous breathing? I-1911
    a. Positive intrathoracic pressure that causes less resistance and assists in venous return
    b. Negative intrathoracic pressure that causes increased resistance and impedes in adequate venous return
    c. Positive intrathoracic pressure that causes increased resistance and impedes venous return
    d. Negative intrathoracic pressure that causes less resistance and assists in venous return
32. What the flow pattern of a pressure delivered breath? II-1456
    a. Constant
    b. Accelerating
    c. Decelerating

d. Variable

33. How does increasing the tidal volume allow more CO2 removal? I-1138
    a. Allows more surface area for the transfer of CO2
    b. Increases the mean airway pressure
    c. Allows the alveoli to remain open longer for gas exchange
    d. Improves compliance
34. Since tidal volume is limited, what else can we adjust to improve minute ventilation? I-1138
    a. Inspiratory time
    b. FiO_2
    c. Respiratory Rate
    d. Expiratory time
35. What is a static pressure that the alveoli see? II-1026
    a. Positive end expiratory pressure (PEEP)
    b. Driving pressure
    c. Plateau pressure (PPlat)
    d. Peak Inspiratory Pressure (PIP)
36. Why do patients with obstructive lung disease need a shorter respiratory rate? I-1245
    a. Gives the patients time to rest
    b. Shorter respiratory rate allows a longer expiratory time as they have trouble with air removal
    c. Shorter respiratory rate allows for less positive end expiratory pressure
    d. Shorter respiratory rate allows for longer inspiratory time to improve oxygenation
37. What is dead space ventilation? I-1058
    a. Carbon dioxide in the unventilated alveoli
    b. Carbon dioxide delivered to the patient if the patient isn't on 100% oxygen
    c. Carbon dioxide that is unable to diffuse out of the capillaries
    d. Carbon dioxide still in the airway at expiration
38. What happens to blood return to the right atrium with positive pressure ventilation? I-1932, 2010
    a. Positive intrathoracic pressure that causes less resistance and assists in venous return
    b. Negative intrathoracic pressure that causes increased resistance and impedes in adequate venous return
    c. Positive intrathoracic pressure that causes increased resistance and impedes venous return
    d. Negative intrathoracic pressure that causes less resistance and assists in venous return
39. What is the injury to the alveoli caused by excessive pressure from the ventilator called? I-1406
    a. Barotrauma
    b. Volumtrauma
    c. Atelectotrauma
    d. Biotrauma
    e. Oxygen toxicity
40. What is the normal I:E ratio? I-0844
    a. Inspiration is longer than expiration
    b. Expiration is longer than inspiration
    c. Inspiration and expiration are equal
41. What is the injury from repetitively opening and closing lung units (a type of sheering stress to the lung) called? I-1416
    a. Barotrauma
    b. Volumtrauma
    c. Atelectotrauma
    d. Biotrauma
    e. Oxygen toxicity
    f. Higher oxygen requirements leading to oxygen toxicity
42. What happens with adequate PEEP? I-1803
    a. Better driving pressure
    b. Less pressure is needed to re-expand the alveoli at the end of expiration
    c. Improved minute ventilation

d. Lower oxygen requirements thus decreasing risk of barotrauma

43. What is the difference between the plateau pressure (PPlat) and the positive end expiratory pressure (PEEP)? I-1825
    a. Driving pressure
    b. Static pressure
    c. Dynamic Pressure
    d. Compliance
44. How can you help improve venous return in a patient on positive pressure ventilation? I-1944
    a. If the patient has decreased intravascular volume, a fluid bolus will help
    b. Higher levels of positive end expiratory pressure (PEEP)
    c. Increase the volume/pressure breath (depends on the mode)
    d. Trial of bronchodilators to decrease afterload
45. What happens to the right ventricle with positive pressure ventilation? I-2048
    a. Decreased right ventricular afterload
    b. Increased right ventricular preload
    c. No significant changes to the right ventricle
    d. Increased right ventricular afterload
46. Will all patients have perfect carbon dioxide and oxygen levels? I-0230
    a. Yes
    b. No
47. What is the lung injury resulting from inflammatory mediators called? I-1438
    a. Barotrauma
    b. Volumtrauma
    c. Atelectotrauma
    d. Biotrauma
    e. Oxygen toxicity
48. What happens if you intubate a patient with RV failure? I-2048
    a. Nothing with rapid sequence intubation technique
    b. Improved pre-load to the RV
    c. RV collapse and cardiac arrest
    d. Increased ejection fraction of the right ventricle
49. What happens to the left ventricle with positive pressure ventilation? I-2128
    a. Increased stroke volume and increased cardiac output
    b. Decreased stroke volume and decreased cardiac output
    c. Increased heart rate and increased cardiac output
    d. Decreased heart rate and decreased cardiac output
50. Which of the following is not a type of breath that can be delivered by a ventilator? II-0216
    a. Controlled
    b. Assisted
    c. Manuel
    d. Spontaneous
51. What are the two types of breath delivery? II-0228
    a. FiO_2, PEEP
    b. Volume, pressure
    c. Flow, volume
    d. Respiratory rate and tidal volume
52. What type of breath requires no work by the patient, as the frequency/rate of the breath and the amount of gas delivered is fully dependent on the ventilator? II-0318
    a. Controlled
    b. Assisted
    c. Manuel
    d. Supported
53. How do you check the plateau pressure (PPlat), on a pressure mode? II-1026
    a. Inspiratory pause
    b. Expiratory pause
    c. Same as the peak inspiratory pressure (PIP)

d. Ask the respiratory therapist

54. With what type of breath does the patient do most/all of the work, and the ventilator gives only minimal assistance, if needed? II-0405
    a. Controlled
    b. Assisted
    c. Manuel
    d. Supported
55. What is controlled mandatory ventilation (CMV)? II-0551
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
56. What is pressure support? II-0535
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
57. What is assist controlled ventilation (ACV)? II-0600
    a. A combination of a controlled/assisted breathing with a spontaneous breath
    b. A way for the ventilator to assist/ augment the efforts of the patient
    c. A controlled form of ventilation where the ventilator controls the rate and the amount of gas
    d. A combination of controlled and assisted breath
58. In which mode of ventilation is a pre-set amount of gas delivered to the patient? II-0632
    a. Volume breath
    b. Pressure Breath
    c. Both
    d. Neither
59. When giving a volume breath, at what pressure will the gas be delivered? II-0650
    a. Depends on compliance
    b. 6-8 ml / kg of ideal body weight
    c. Depends on the respiratory rate
    d. Depends on the flow and inspiratory time
60. In which mode of ventilation will a pre-set pressure deliver gas to the patient? II-0730
    a. Volume breath
    b. Pressure Breath
    c. Both
    d. Neither
61. What are ways to maximize patient comfort on the ventilator? I-0110
    a. Optimize ventilation settings
    b. Sedation
    c. Paralytics
    d. All of the above
62. When giving a pressure breath, how much volume of gas will be delivered to a patient? II-0747
    a. Depends on compliance
    b. 6-8 ml / kg of ideal body weight
    c. Depends on the respiratory rate
    d. Depends on the flow and inspiratory time
63. How do you check the plateau pressure (PPlat), on a volume mode? II-1026
    a. Inspiratory pause
    b. Expiratory pause
    c. Same as the peak inspiratory pressure (PIP)
    d. Ask the respiratory therapist

64. What does it mean when there is increased peak inspiratory pressure (PIP) and increased plateau pressure (PPlat)? II-1106
    a. High resistance in the circuit or patient
    b. Poor pulmonary perfusion
    c. Need to change the ventilator mode
    d. Decreased compliance
65. Which is not a cause of increased peak inspiratory pressure (PIP) and increased plateau pressure (PPlat)? II-1106
    a. Pulmonary edema
    b. Bronchospasms
    c. Pneumothorax
    d. Abdominal compartment syndrome
    e. ARDS
66. How does increasing the inspiratory time lead to improved oxygenation? I-0910
    a. It increases mean airway pressure
    b. It decreases expiration time
    c. It improves PEEP
    d. It increases the tidal volume
67. What does it mean when there is increased peak inspiratory pressure (PIP) and low plateau pressure (PPlat)? II-1145
    a. High resistance in the circuit or patient
    b. Decreased compliance
    c. Poor pulmonary perfusion
    d. Need to change the ventilator mode
68. Which is not a cause of increased peak inspiratory pressure (PIP) and low plateau pressure (PPlat)? II-1145
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