- If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.
- This handout is for reference only. Non-essential images have been removed for your convenience. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.

Technical issues with the Recording?

- Clear browser cache using these instructions
- Switch to another browser
- Use a hardwired Internet connection
- Restart your computer/device

Still having issues?

- Call 866-782-6258 (M-F, 8 AM-8 PM ET)
- Email customerservice@PhysicalTherapy.com

PHYSICALTHERAPY.com

My Patient Is on a Ventilator! Now What?

1. The primary controls to monitor and/or correct oxygenation are which of the following:

A. Fi02 and Tidal Volume (Vt)
B. Fi02 and PEEP
C. Respiratory Rate (f) and Tidal Volume (Vt)
D. Respiratory Rate (f) and PEEP

2. In a pressure support setting, the following are true except:

A. This applies to spontaneous breaths only
B. A pre-set value of positive pressure is delivered
C. This support setting augments the tidal volume (Vt)
D. Usually set above 30 cmHg

3. The following ventilator values are shown: 5 cmH20. 440 mL. 40%. 22. What monitoring parameters are indicated in the order of the values above?

A. PEEP. Fi02. Vt. f(RR).
B. Fi02. PEEP. f(RR). Vt.
C. Vt. PEEP. f(RR). Fi02.
D. PEEP. Vt. Fi02. f(RR).

4. The following parameters may indicate your patient may be ready to extubate, except:

A. RR < 35 with activity
B. Pressure Support (PS) of 5
C. PEEP > 10 cmH20
D. Vt > 450 for a 65 kg male

5. An airways disease characterized by a problem with ventilation will present with the following signs except:

A. Air trapping
B. Increased PaC02
C. Decreased Pa02
D. Enlarged lungs on chest X-RAY

6. Tidal volume (Vt) generally uses the ideal body weight (IBW) based on gender and height, using the formula: 6-8 mL/kg x IBW. What would you expect for a 65 kg male to minimally achieve (approximate value)?

A. 800 mL
B. 600mL
C. 200mL
D. 400mL

7. What is the most important criteria that determines the decision to extubate?

A. The patients primary cause for mechanical ventilation (MV) is reversed
B. The patient is very well oxygenated on an Fi02 of 24%
C. The patient no longer demonstrates dyspnea
D. The patient successfully passes a spontaneous breathing trial for 1 hour

8. What is a contraindication to mobilizing a patient on mechanical ventilation (MV)?

A. Sp02 > 90%
B. Fi02 > 80%
C. PEEP < 10 cmH20
D. RR < 35

9. The following is an example of invasive ventilation:

A. Bag-mask valve
B. Endotracheal Tubing (ETT)
C. CPAP
D. BPAP

10. This ventilatory strategy aims to keep airways open by providing back pressure during the maneuver:

A. Pursed Lip Breathing
B. Sustained breath holds
C. Breath Stacking
D. Valsalva maneuver

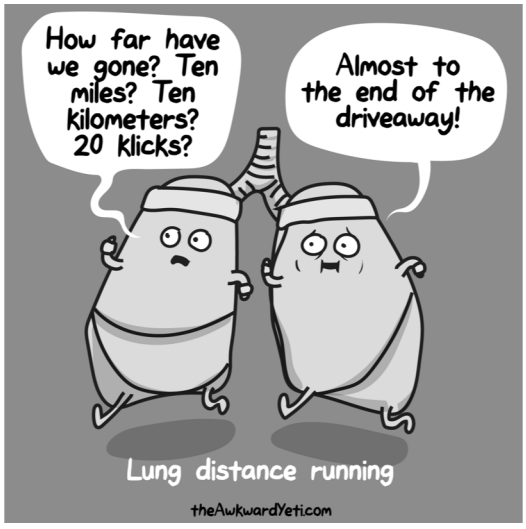


Image used with permission from theAwkwardYeti.com

My Patient is on a Ventilator. Now what?

Maria Cecilia ZS "Kreek't" Rebano

CONTINUED

Learning Outcomes

After this course, participants will be able to:

- Differentiate between non-invasive and invasive mechanical ventilation (MV).
- Identify at least three ventilator mode and settings.
- List at least two MV parameters for monitoring oxygenation.
- List at least two MV parameters for monitoring ventilation.
- List at least five precautions when working with patients requiring MV.
- List at least five contraindications to mobilizing patients requiring MV and 1-2 exceptions.

CONTINUED

Learning Outcomes (cont.)

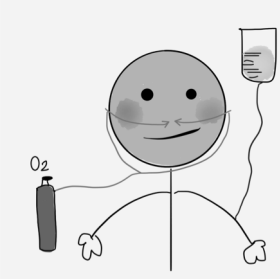
- Accurately identify at least four elements or factors determining readiness for weaning.
- List at least three reasons why weaning failure occurs.
- Describe the mechanics of respiration, respiratory control, respiratory distress.
- List at least three ventilatory strategies for each: restrictive support, obstructive support.

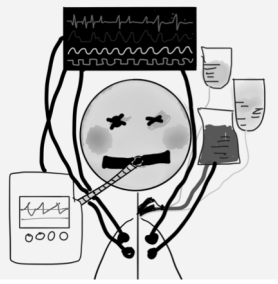
CONTINUED

CONTINUED

Patient Vitals

	130/72	118/55	2+ pressors
	88	74	external pacer
	20	16	intubated
	92%	96%	FiO2 80%





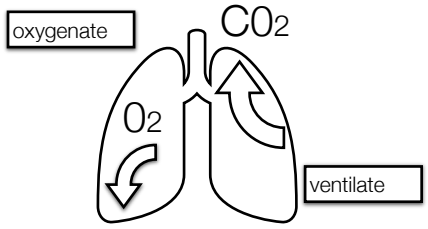
CONTINUED

The Language and Mechanics of Respiration

- Respiration
- Distress and Failure
- Mechanical Ventilation

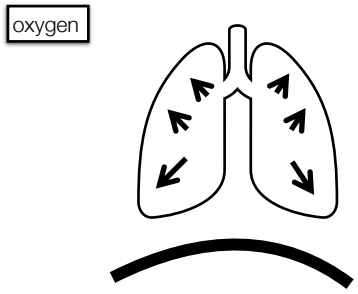
CONTINUED

Respiration



CONTINUED

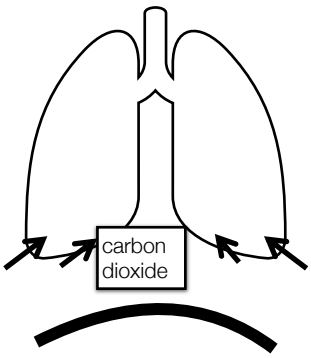
Oxygenation



Inspiration: active, generate neg pressure, obtain volume

CONTINUED

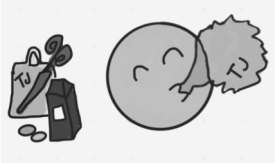
Ventilation



Expiration: passive, positive pressure, recoil

CONTINUED

High compliance
pliable lungs = grocery bag
ex: emphysema



- Compliance - ability of lung tissues to stretch

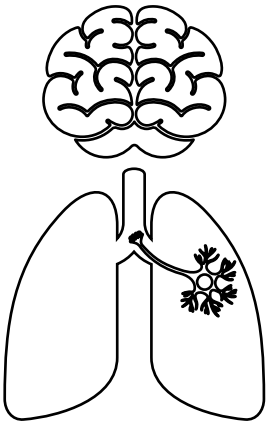
Low compliance
stiff lungs = thick balloon
ex: fibrosis, scarring

CONTINUED

CONTINUED

Respiration

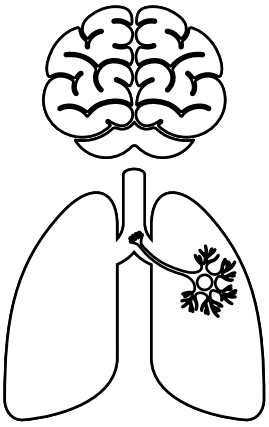
- neural drive
- neuromusculoskeletal integrity
- clear airways
- intact parenchyma
- cardiovascular patency



CONTINUED

Respiration

- neural drive
- neuromusculoskeletal integrity
- clear airways
- intact parenchyma
- cardiovascular patency

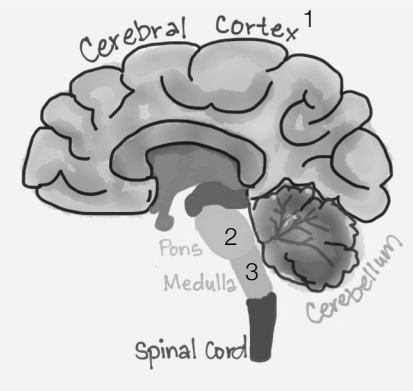


CONTINUED

CONTINUED

Control Centers

- Neural



Voluntary Ventilation

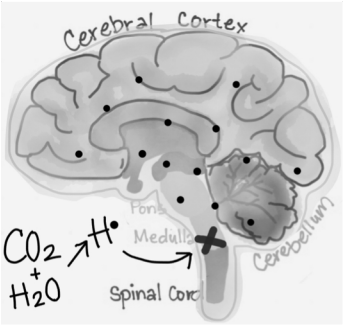
Pneumotaxic (RR, Depth)

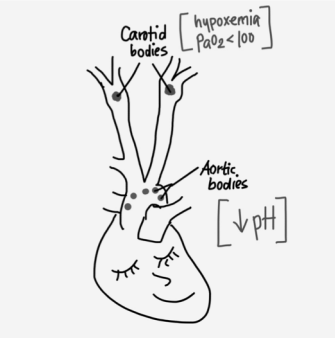
Rhythmicity, Automaticity

CONTINUED

Control Centers

- Chemical





Chemoreceptors send messages to maintain homeostasis by effecting respiratory centers to modify:

Rate of breathing, depth of breathing, or both.

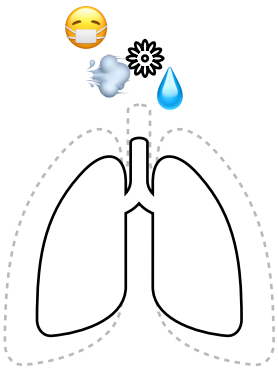
CONTINUED

CONTINUED

Control Centers

- Mechanical (non-chemical/irritants)

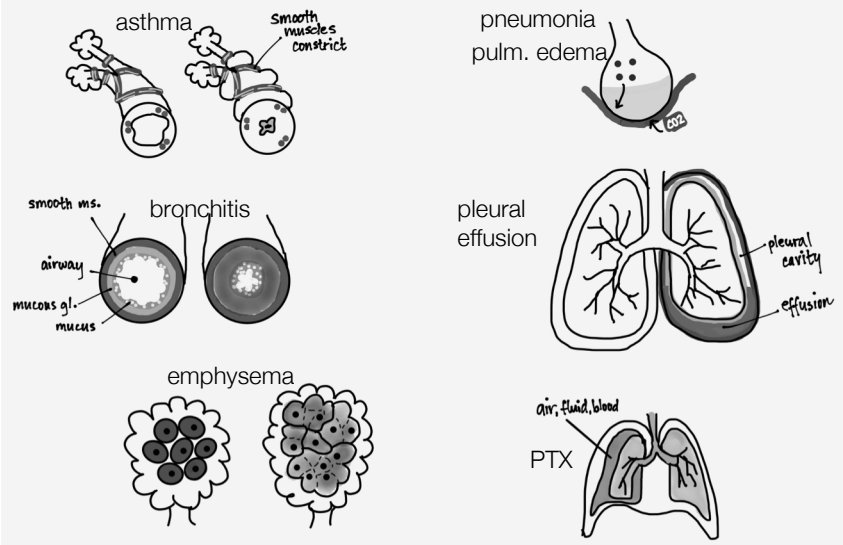
Coughing/Mucus
Aspiration
Bronchospasm
Pain/Stressors



hering-breuer reflex
deflation reflex
j-receptors

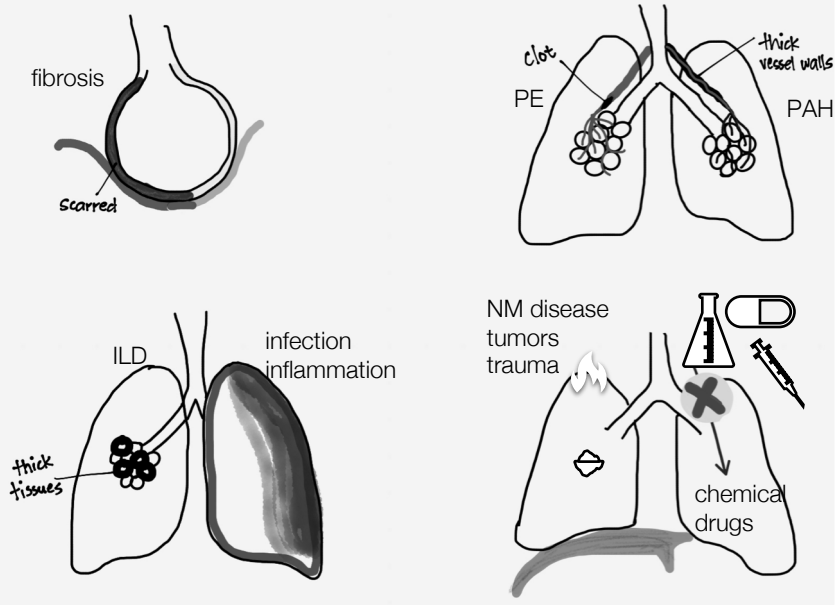
CONTINUED

Respiratory Insult



CONTINUED

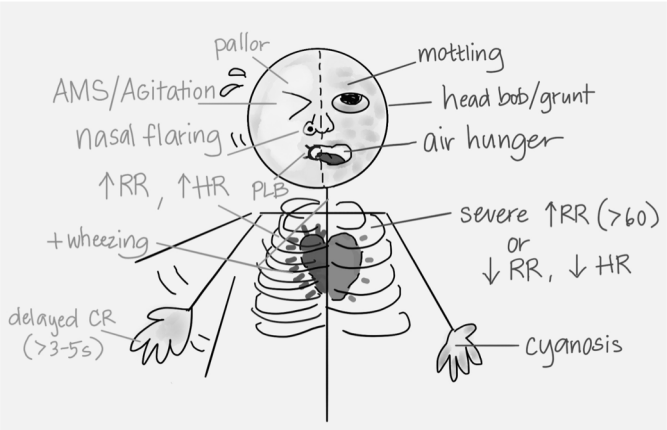
Respiratory Insult



Respiratory Distress and Failure

DISTRESS

FAILURE



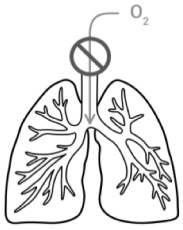
maintaining respiration only by increased WOB

inability to compensate despite respiratory efforts

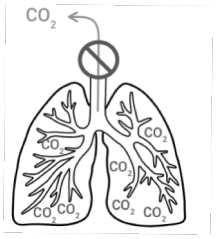
CONTINUED

Respiratory Distress and Failure

- Hypoxia / Hypoxemia



- Hypercarbia / Hypercapnia



- Pulmonary Function Tests
- V/Q Scans - examine airflow and blood flow
- ABGs - how well lungs move (Pa)0_2 (Pa)$C0_2$ in blood

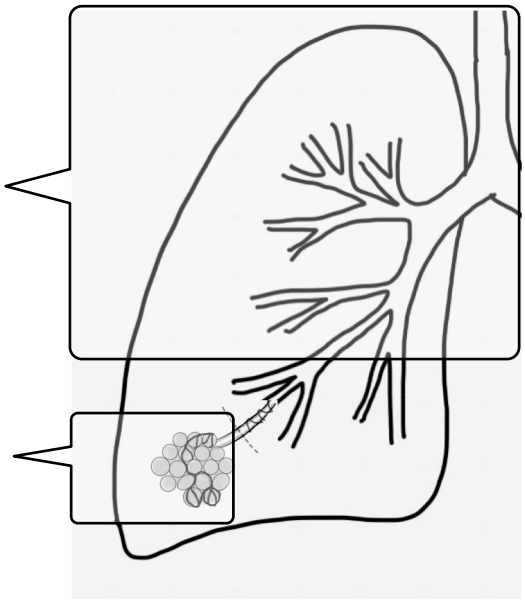
Respiratory Failure in Clinical Trials:
1. Tachypnea.
2. Abnormal blood gases.
3. Work of breathing.

Images used with permission from www.medmastery.com " Mechanical Ventilation Essentials"

CONTINUED

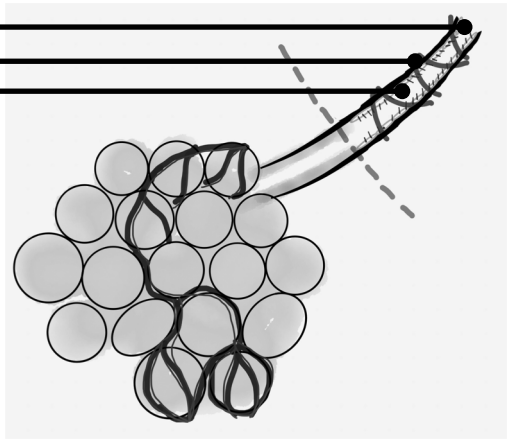
Airway vs Alveolar

- Airway disease
- Alveolar disease



Respiratory Unit

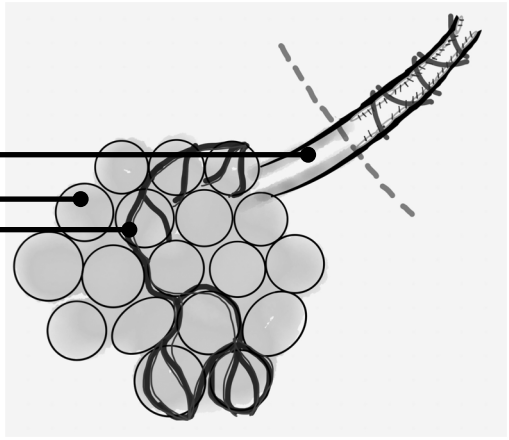
terminal bronchioles
smooth muscle
ciliated epithelium



Conducting zone

Respiratory Unit

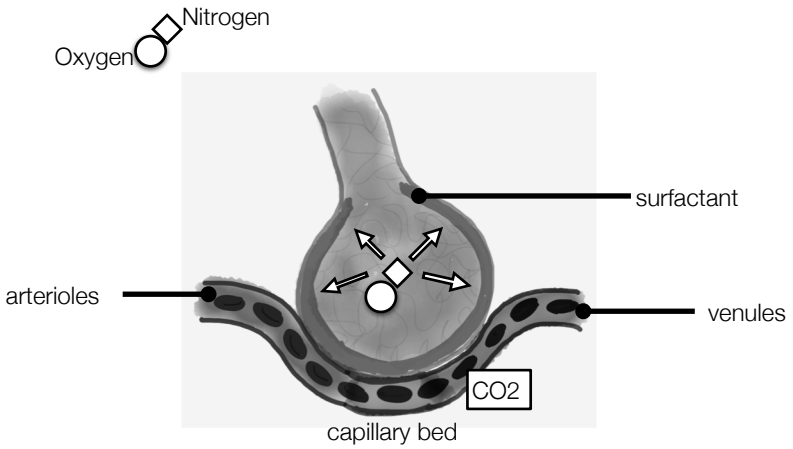
respiratory bronchioles
alveoli
capillary bed



Respiratory zone

CONTINUED

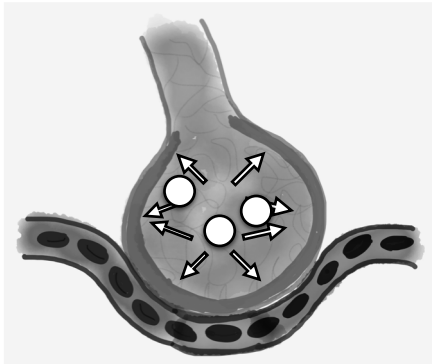
Alveolus



CONTINUED

Oxygenating (increasing oxygen)

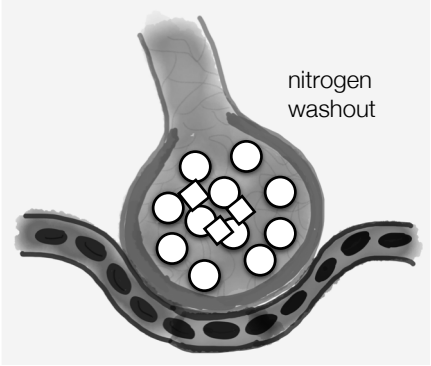
more 02 concentration
increased Fi02



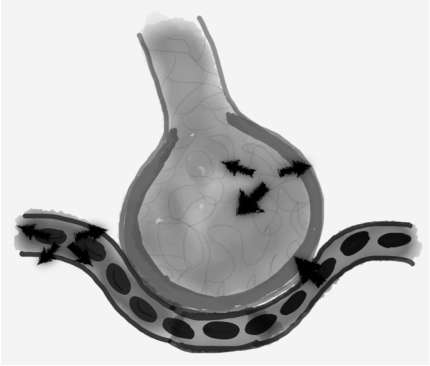
keep alveoli open
increased PEEP

CONTINUED

Dangers of too much 02

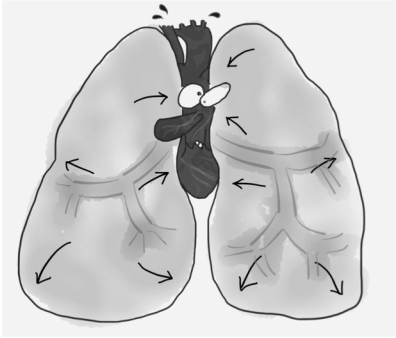


absorption atelectasis

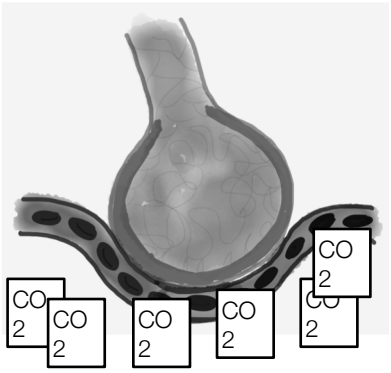


tissue destruction from 02 toxicity

Dangers of too much 02

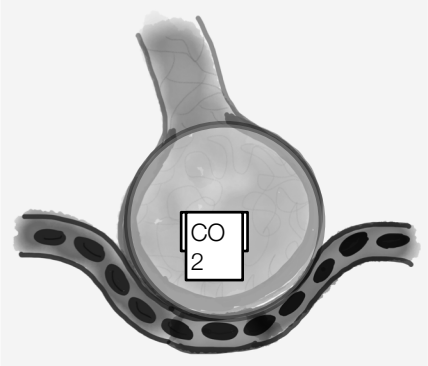


cardiovascular compromise

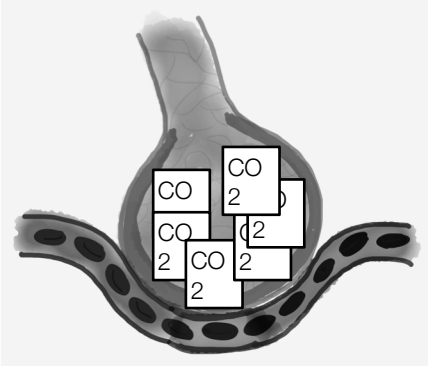


indirect CO2 narcosis

Ventilating (removing carbon dioxide)

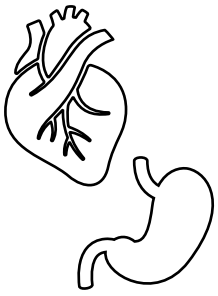


depth of breathing
increasing tidal volume

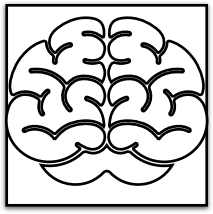


breathe faster
respiratory rate

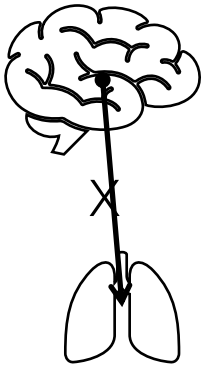
Dangers of too much CO2



acidosis
(acidemia)



cerebral
vasodilation



depressed
drive

Outside in and Inside out

Key concepts

Oxygen delivery

Correct oxygenation, ventilation, or both

- Positive Pressure Ventilation
- Non-invasive vs Invasive

Bag-Mask Valve Artificial Breaths (CPR)
CPAP
BPAP
HFNC
} constant pressures delivered

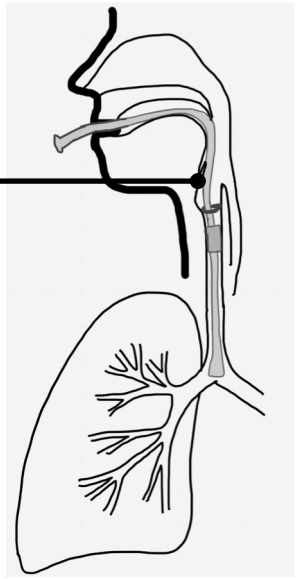
ETT (endotracheal tube)
TT (tracheostomy tube)
} artificial airways

- Provide concentrated oxygen: Fi02 vs LPM
- Deliver volume, pressure, breaths

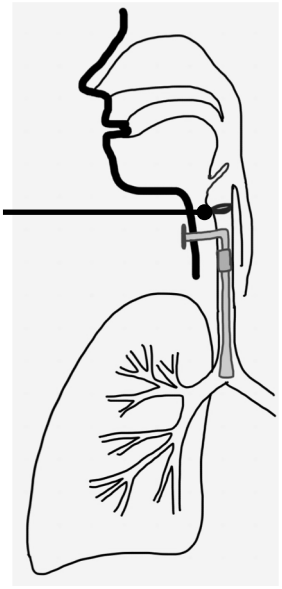
CONTINUED

Invasive Mechanical Ventilation

- ETT

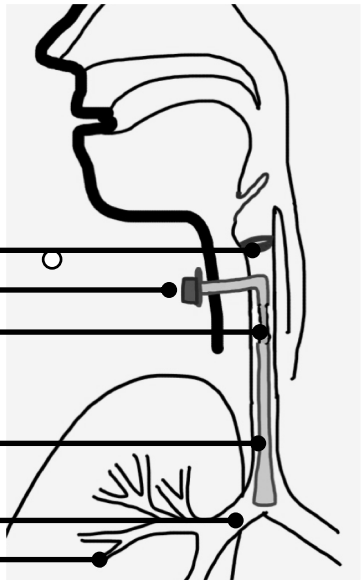


- TT



CONTINUED

Speech Function



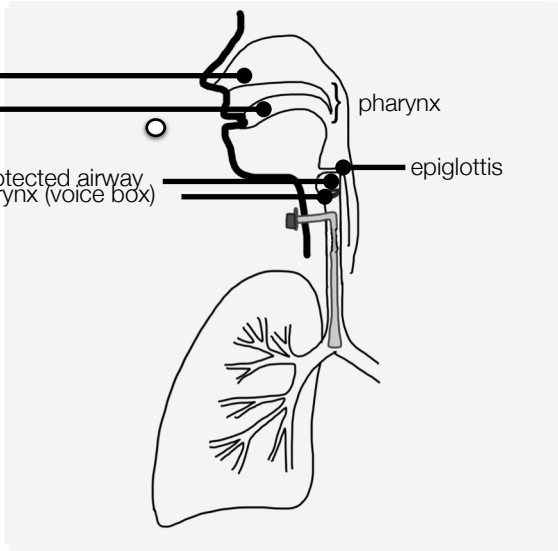
- Lower airways

CONTINUED

CONTINUED

Swallowing Function

- Upper airways



CONTINUED

Oxygen Delivery

- Fi02 (02 concentration vs flow)

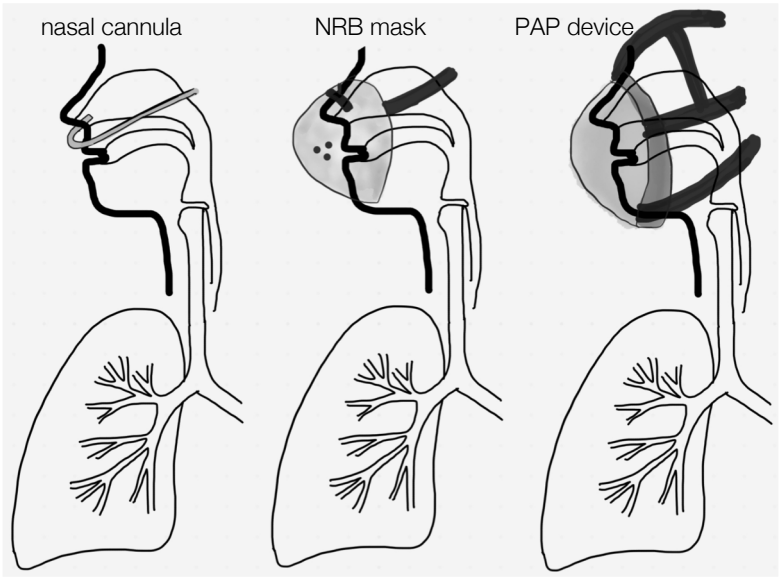
Device	Flow	FiO2*
Nasal Cannula	6 LPM	40%
Simple Mask	6 LPM	35-50%
NRB	6 LPM	60%
HFNC	50 LPM	26%
Trach Collar	15 LPM	30%
ETT, TT	60-120 LPM	up to 100%

*approximate values

CONTINUED

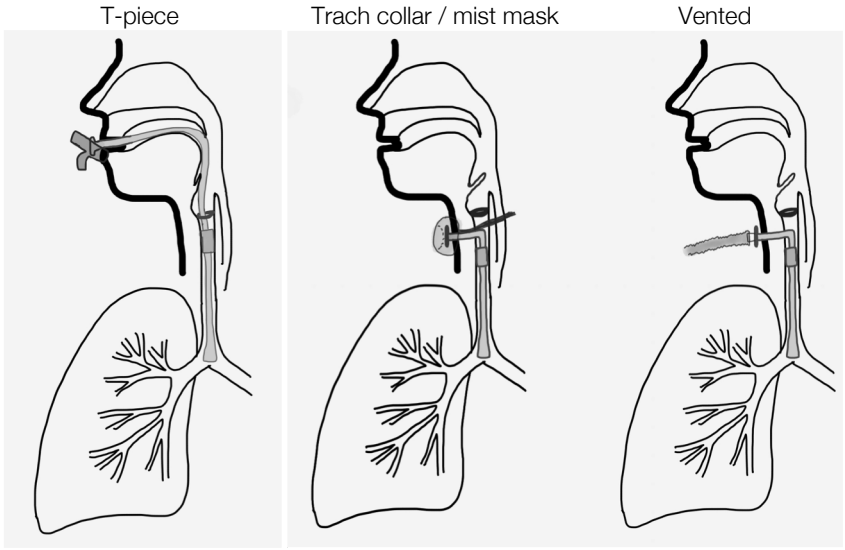
CONTINUED

Oxygen Delivery



CONTINUED

Oxygen Delivery



CONTINUED

Mobilizing the Patient

RT MUST BE PRESENT AT ALL TIMES

When mobilizing a patient on the ventilator.

Perform MV setting adjustments

Select appropriate O2 delivery devices

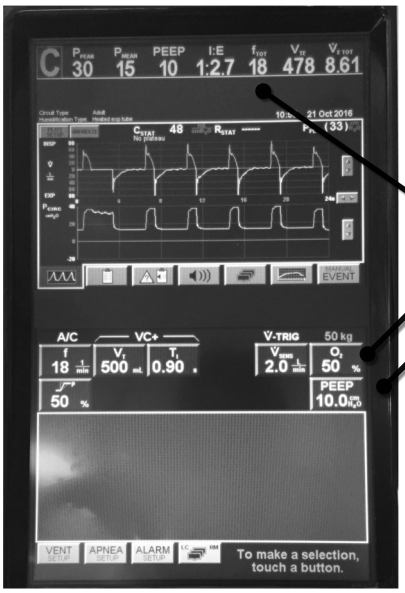
Provide bronchodilator therapies

Contraindications to Mobilizing

- Pt on paralytics
- Unresponsive to instructions or stimuli
- Open chests or abdomens*
- Pt excessively anxious, fearful, diaphoretic
- MV: Fi02 requirements >60%*
- MV: PEEP requirements >10 cmH20*
- CV: pressor changes in last 2 hours
- CV: ECMO, PAC
- acutely worsening neuro-cardiac-pulmo

Control Mode, Assist Mode, (Assist-Control) Modes

- Control - breath is initiated by the machine, most often seen when Pts are on paralytics, or Pt has no use of respiratory muscles (Therapies contraindicated)
- Assist - breath is initiated (triggered) by the patient, then the ventilator either:
    1. delivers support via preset volume (Volume Control) or preset pressure (Pressure Control)
    2. delivers a breath to maintain a set RR if Pt doesn't trigger a breath



C — Control

A — Assist

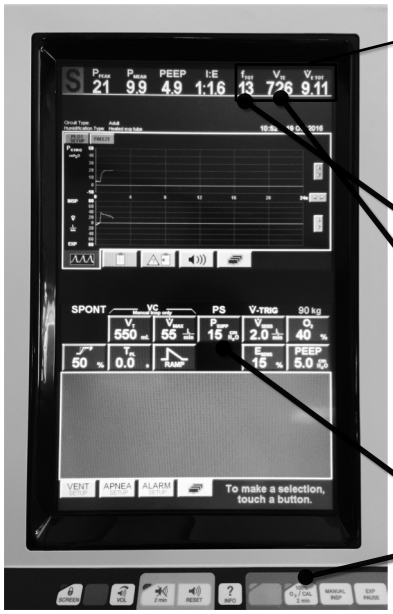
- RR increases with exercise
- Currently delivered Fi02
- Higher PEEP=need more oxygenation/keep alveoli open

Pt support with exercise:

- Inc. 02 (100% button)
- Remember Ambu bag check before moving Pt

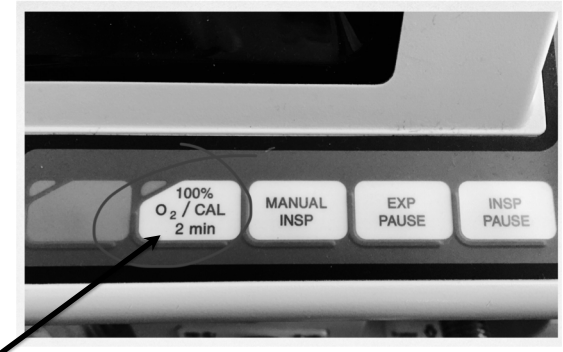
Spontaneous Breathing and Support Modes/Settings

- Positive end-expiratory Pressure (PEEP) - pressure applied upon expiration to keep alveoli open, increasing Pa02
- Pressure Support (PS) - Pt triggers all breaths and there is a constant set inspiratory pressure level. If there is a lung/thorax mechanical change, or a change in Pt's effort, Tidal Volume (Vt) will be affected, so PS amount must be adjusted
- CPAP or BPAP - similar to PS but non-invasive



CONTINUED

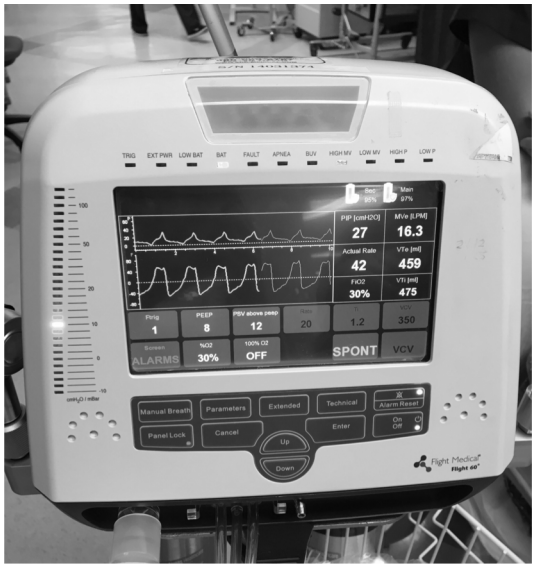
DO NOT ADJUST ANY SETTINGS ON THE VENTILATOR



*Therapists can press 100% 02 ANY TIME the Pt requires it. This button will provide oxygenation for 2 minutes.

CONTINUED

The portable ventilator



Can you identify:

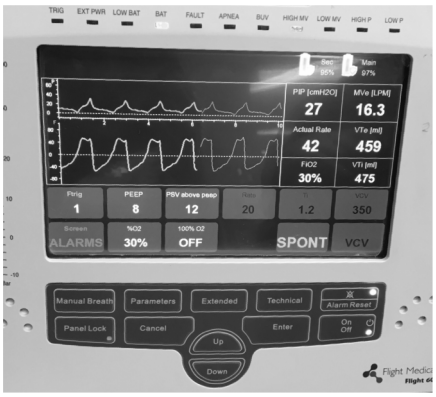
- Ventilator Mode
- Tidal Volume
- Respiratory rate
- Fi02
- PEEP
- Other info?

44

CONTINUED

CONTINUED

MV Parameters



- Document position of ETT before and after treatment
  ex: 25 cm at teeth
- Document ventilator pre-set parameters
  ex: Spontaneous w/PS of 12
  Vt 350, f 20, Fi02 30%, PEEP 8
- Document patient response via vent settings
- Document flow (LPM) and Fi02 (%)
  ex: 50 LPM on HFNC, Fi02 35%
  ex: 6 LPM on trach collar, Fi02 30%

Spontaneous Mode PS 12
Vt 459 ml, RR 42 — ventilation parameters
Fi02 30%, PEEP 8 cmH20 — oxygenation parameters

45

CONTINUED

How can I help?

Weaning trials

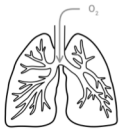
Pulmonary Toilet

Screening for Weaning

Patient Status during therapy

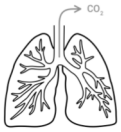
1. Oxygenation status

$SpO_2 \geq 90\%$ on $FiO_2 \leq 40\%$
PEEP ≤ 5 cmH_2O



2. Ventilation status

< 35 breaths / minute



3. Hemodynamic status

No active myocardial infarction
No (or low) vasopressor infusion

Hemoglobin >7
No significant ECG changes

4. Sedation status

No neuromuscular blocking agents

RASS 0 to -1

Parameters for Weaning

WOB*	O2
RSBI** <100	FiO2 <40%
No dyspnea	PEEP <5-8
RR <35	PS <10
accessory ms	maintain sats

Neuro	Psych
Awake	↓ Fear
Alert	↓ Anxiety
GCS >8	↓ Pain
No seizures	↓ Stress
Follows instructions	

Images used with permission from www.medmastery.com " Mechanical Ventilation Essentials"

Parameters for therapists

- Incentive spirometry
- DBE
- Diaphragmatic recruitment
- Breath stacking

1. Tidal volume (V_T)

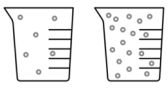
2. Respiratory rate (RR)

Ventilation

- Paced breathing
- Dyspnea control
- Volition

3. PEEP

4. FiO_2



Oxygenation

- PLB
- PEP
- Premedicate*

- Titrate 02

Images used with permission from www.medmastery.com " Mechanical Ventilation Essentials"

Muscular Support

- Upper airways
- Lower airways } pharyngeal-laryngeal and smooth muscles
- Inhalation
- Exhalation } diaphragm+intercostals and passive recoil
- Effortful Inspiration
- Forced Exhalation
- Coughing

Muscular Support

- Accessory Breathing

SCM

Scalenes

Traps

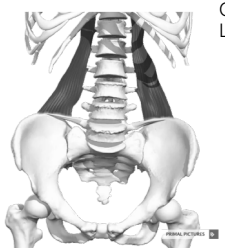
Pec Major

Pec Minor

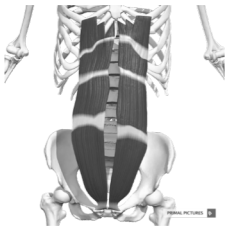
CONTINUED

Muscular Support

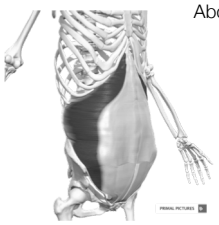
- Forced Expiration



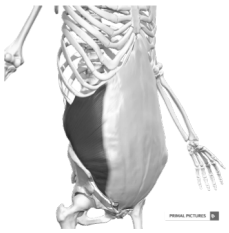
Quadratus Lumborum



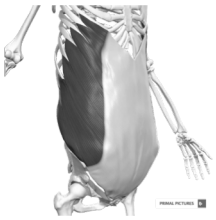
Rectus abdominis



Transverse Abdominis



Internal Obliques



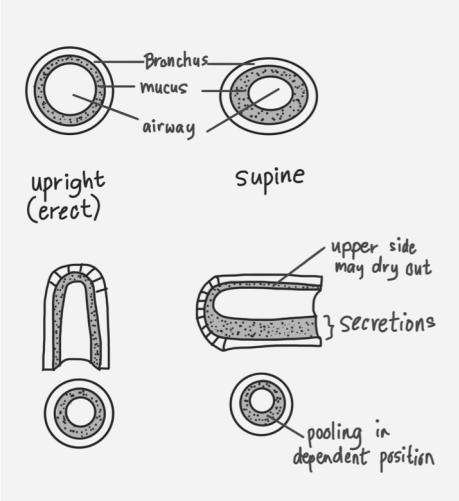
External Obliques

CONTINUED

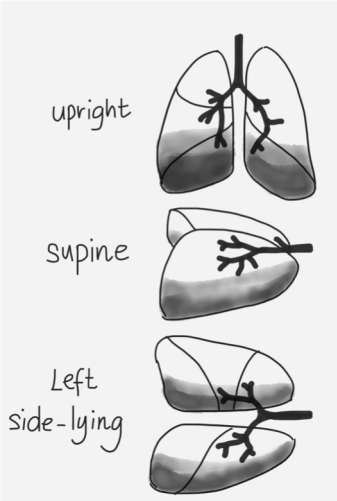
Cough

- Phases of cough
- Function of mucus (affected by hydration)
- Mucociliary transport
- Requires glottal closure (unable with ETT)

AIRWAY RESPONSE



"PERFUSION"



BREATHLESSNESS POSITIONS

REST AND RECOVERY

- Timed rests
- Dyspnea scales
- Sleep
- Caregiver assist
- Mobility devices
- Premedication
- Mealtimes

Failure to Wean (extubate)

- Primary cause of failure not corrected
- Physiologic co-morbidities preventing success
- High risk for failure after extubation
- ICU acquired weakness
- Bridge to lung transplants
- Wean to PAP/CNVS

Thank you.
Questions!

CONTINUED

References

- On a separate set of slides