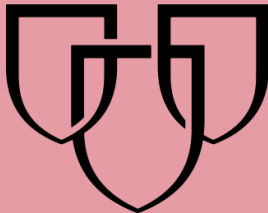



# MAYO CLINIC MECHANICAL VENTILATION GUIDE

RESP FAILURE	GOALS	INITIAL SETTINGS		MONITORING	TARGETS	
				6 P's	BASIC	
	HEMODYNAMIC STABILITY	 <p>Start Here</p> 		1	BLOOD PRESSURE	SBP > 90mmHg
	BAROTRAUMA PREVENTION			2	PEAK INSPIRATORY PRESSURE (PIP)	< 35cmH <sub>2</sub> O
				3	PLATEAU PRESSURE (P <sub>PLAT</sub> )	< 30cmH <sub>2</sub> O
VOLUTRAUMA PREVENTION				TIDAL VOLUME (V <sub>T</sub> )	~ 6-8cc/kg IBW	
Loss of Airway	AIRWAY MAINTENANCE	Female ETT Male ETT	7.0-7.5 8.0-8.5	AIRWAY	AIRWAY / ETT / TRACH	Patent
Hypoxia	OXYGENATION	F <sub>I</sub> O <sub>2</sub> PEEP	21 - 100% 5 [5-15]	GAS EXCHANGE	PULSE OXIMETRY (SpO <sub>2</sub> ) pO <sub>2</sub>	> 90% > 60mmHg
Hypercapnia	VENTILATION	TIDAL VOLUME BPM (RR)	5'5" = 350cc [max 600] 6'0" = 450cc [max 750] 6'5" = 500cc [max 850] 14 [10-30]	GAS EXCHANGE	pCO <sub>2</sub> ETCO <sub>2</sub> pH MINUTE VENTILATION (V <sub>MIN</sub> )	40mmHg 45 7.4 > 5L/min
High Work of Breathing (WOB)	SYNCHRONY	MODE	ASSIST CONTROL VOLUME or PRESSURE AC (V) / AC (P)	COMFORT	WORK OF BREATHING	Decreased
	SUPPORT				PATIENT-VENTILATOR SYNCHRONY	Comfortable Breaths

## 2<sup>0</sup> ASSESSMENT



1. Recognize **Signs of Shock** → Work-up and Manage
2. Assess 6Ps → If single problem → Troubleshoot Cause
3. If Multiple Problems → QUICK FIX → Troubleshoot Cause(s)

PROBLEMS

HYPOTENSION

HYPOXIA  
HYPOVENTILATION

BAROTRAUMA

DYSSYNCHRONY

autoPEEP



# CAUSES

# QUICK FIX

# MANAGEMENT

## HYPOTENSION (↓BP)

↓ Cardiac Output

↓ Tone

<b>HYPOVOLEMIA</b>
<b>OBSTRUCTED BLOOD RETURN</b>
<b>CARDIAC FAILURE</b>
<b>VASODILATION</b>

Bleeding
Dehydration
3 <sup>rd</sup> Spacing
Pneumothorax
Abdominal Compartment Syndrome
Air-Trapping (AutoPEEP)
PEEP
Cardiac Tamponade
Stun, Contusion, Chronic HF
Ischemia/Infarction
Arrhythmia
Diastolic or Valve Dysfunction
Right Heart Failure
Infection
Spinal Shock & Anaphylaxis
Medications

<b>FLUID</b> (if not hypoxic)
<b>EPINEPHRINE</b> (if not tachy)
<b>↓ PEEP</b> (if not hypoxic)

Hemostasis, Transfuse, Treat cause, Temperature control
Fluid Resuscitation (End points = hypoxia, ↑StO <sub>2</sub> , ↓PVI)
Treat cause, Beware of hypoxia (3 <sup>rd</sup> spacing in lungs)
Needle D, Chest tube
Treat Cause, Paralyze, Surgery (Open Abdomen)
Pop off vent & <b>SEE SEPARATE CHART</b>
Reduce PEEP
Pericardiocentesis, Drain. Avoid mechanical ventilation if possible
Time, Rest (Sedate), Avoid cardiac stress
ASA (if no trauma), Maintain SBP >90, SpO <sub>2</sub> > 90%, ?Transfuse
Treat cause (i.e. ischemia, electrolytes), Anti-arrhythmic, Cardiovert
Treatment dependent on cause
Treat cause (i.e. PE). Avoid high PEEP, hypoxia, acidosis
Treat infection, Source control, Consider Epi
Treat cause, ?Epi. Diphenhydramine
<b>Avoid / Adjust precipitating meds (i.e. sedatives, narcotics, TIVA)</b>

## BAROTRAUMA (↑PIP)

<b>LUNG DISEASE / INJURY</b>
<b>LUNG COMPRESSION</b>
<b>DYSSYNCHRONY</b>
<b>AIR-TRAPPING</b>
<b>VENTILATOR SETTINGS</b>

Lung Injury / ARDS / Contusion
Pneumonia
Cardiogenic Pulmonary Edema
Alveolar Hemorrhage
Pneumothorax
Hemothorax / Effusion
Abdominal Compartment Syndrome
Atelectasis
<i>SEE SEPARATE CHART</i>
Incomplete Exhalation & Airway Obstruction
↑ PEEP
↑ Tidal Volumes

<b>POP OFF VENT</b> (if air-trapping)
<b>SUCTION</b>
<b>BAG VENTILATE</b>

Treat cause (i.e. Blast, Infection, Inhalation, Trauma)
Antibiotics, Pulmonary/Oral hygiene, Aspiration prevention
↑PEEP (& ↓Tidal Volume), Treat HF cause
Treat cause, Consider ↑PEEP, Limit suctioning, Fix coags
Needle D, Chest tube
Thoracentesis, Chest tube, Fix injury/Surgery, Transfuse
Treat Cause, Sedate/Paralyze, Surgery
Bag w/ PEEP valve, Recruitment, Patient re-positioning
<i>SEE SEPARATE CHART</i>
<i>SEE SEPARATE CHART</i>
Weigh risk & need for current PEEP
Weigh risk & need for current Tidal Volume

## autoPEEP

<b>DYSSYNCHRONY</b>
<b>AIRWAY DISEASE</b>
<b>VENTILATOR SETTINGS</b>

<i>SEE SEPARATE CHART</i>
ETT Obstruction
Airway Secretions / Debris
Severe Bronchoconstriction
↑ I:E Ratio
↑ RR

<b>SEDATE &amp; PARALYZE</b>
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<i>SEE SEPARATE CHART</i>
Suction, Adjust ETT / Trach, Stop biting (Sedate), Bronchoscopy
Pulmonary Toilet, Oral hygiene, Bronchoscopy
Bronchodilator, ↑ Exhalation time (↓ i-Time)
↓ i-Time (Minimum is 0.6 seconds)
↓ RR

## DYSSYNCHRONY

<b>TACHYPNEA (↑RR)</b>
<b>BREATH-STACKING</b>
<b>DEMAND-SUPPORT MISMATCH</b>
<b>AIR-TRAPPING</b>

Pain, Anxiety, Agitation
Metabolic Acidosis
Hypoxia
Low Set Tidal Volume / PIP
Inadequate Support (Mode)
CNS Injury
Thoracic/Lung Injury or Irritation
Auto-Cycling / Auto-Trigging
Gag / Cough / Hiccups
Short i-Time
Long i-Time
Inadequate flow
Low V <sub>T</sub>
Incomplete Exhalation & Airway Obstruction

<b>POP OFF VENT</b> (if air-trapping)
<b>SUCTION</b>
<b>SEDATE &amp; PARALYZE</b> (except w/ CNS injury)

Treat pain, anxiety, agitation
Treat cause, ?NaHCO <sub>3</sub>
<i>SEE SEPARATE CHART</i>
↑ Tidal Volume / PIP
Change mode (Consider AC), ↑RR
Treat underlying cause
Treat cause (i.e. Pneumothorax, ARDS, Inhalation Injury)
Adjust trigger setting on vent
Sedate, Suction, Treat Hiccups
Lengthen i-Time
Shorten i-Time
Change Mode, Unlock flow
Increase Tidal Volume, PC, or PS
<i>SEE SEPARATE CHART</i>

## HYPOXIA (↓SpO<sub>2</sub> / pO<sub>2</sub>)

<b>LOW OXYGEN SUPPLY</b>
<b>AIRWAY DISORDER</b>
<b>AIR SAC (ALVEOLAR) DISEASE</b> (↓ Ventilation)
<b>↓ BLOOD FLOW (Perfusion)</b>

Low FiO <sub>2</sub> (Supply)
ETT / Trach Mal-position
Upper Airway Obstruction
Secretions / Debris
Severe Bronchoconstriction
Lung Disease (ARDS, ALI, ILD, Pneumonia, Pulmonary Edema, Contusion, Alveolar Hemorrhage)
Lung Compression (Pneumothorax, Hemothorax, Effusion, Abdominal Compartment Syndrome, Atelectasis)
Pulmonary Embolus

<b>SUCTION</b>
<b>BAG VENTILATE</b> (unless ETT/Trach in false passage)

↑ FiO <sub>2</sub>
Adjust, replace ETT / Trach, Ensure cuff inflation
Adjust ETT/Trach, Stop biting (Sedate)
Pulmonary Toilet, Oral hygiene
Bronchodilator, ↑ Exhalation time (↓ i-Time)
<b>↑ PEEP &amp; Treat Cause (SEE ↑ PIP CHART)</b>
In severe cases, consider: Paralysis, iNO, Positional therapy, ECMO
Treat Cause (i.e. Needle D, Chest tube)
↑ PEEP if not in shock (i.e. w/ Tension Pneumothorax or Bleeding)
Anticoagulation, O <sub>2</sub> , Monitor for RH failure, iNO, ?TPA if no bleeding

## HYPOVENTILATION (↑ETCO<sub>2</sub> / pCO<sub>2</sub>)

↓ Tidal Volume

↓ RR

<b>AIRWAY HYPOVENTILATION</b>
<b>AIR SAC (ALVEOLAR) HYPOVENTILATION</b> (↓ Compliance)
<b>VENTILATOR SETTINGS</b>
<b>↓ RESPIRATORY DRIVE</b>
<b>VENTILATOR SETTINGS</b>

ETT / Trach Mal-position
Upper Airway Obstruction
Airway Secretions / Debris
Bronchoconstriction
Lung Disease (ARDS, ALI, Pneumonia, Pulmonary Edema, Contusion, Alveolar Hemorrhage)
Lung Compression (Pneumothorax, Hemothorax, Effusion, ACS, Atelectasis)
Air-Trapping (AutoPEEP)
Low Set Tidal Volume
Medications
CNS Injury
Low Set RR
High Trigger Set

<b>POP OFF VENT</b>
<b>SUCTION</b>
<b>BAG VENTILATE</b> (unless ETT/Trach in false passage)
<b>↑ RR</b>
<b>BAG VENT</b>

Adjust, replace ETT / Trach, Ensure cuff inflation
Adjust ETT / Trach, Stop biting (Sedate), Bronchoscopy
Pulmonary Toilet, Oral hygiene, Bronchoscopy
Bronchodilator, ↑ Exhalation time (↓ i-Time)
<b>↑ Tidal Volume, ↑ RR, ↑ PEEP (to recruit lung)</b>
Treat Cause (SEE ↑ PIP CHART)
Maintain lung protective ventilation
Treat Cause (i.e. Needle D, Chest tube, Surgery, PEEP) (SEE ↑ PIP CHART)
<i>SEE SEPARATE CHART</i>
↑ Tidal Volume or PIP (goal 6-8cc/kg IBW)
Re-consider sedative need & dose
Treat cause/injury, Re-consider pCO <sub>2</sub> goal
↑ RR (if RR very high, monitor for AutoPEEP)
Adjust trigger settings