

Episode 40: OR Vent modes

On this episode: Dr. Jed Wolpaw

In this episode, episode 40, I go over the basics of Vent modes and settings in the operating room and how they differ from the ICU. I also discuss a few common special cases and how to adjust the vent to deal with them.

Table of Contents

Hyperlinks to section of notes.

ICU VS. OR DIFFERENCES	2
BASIC MODES	2
CONTROLLED VENTILATOR MODES	2
SPONTANEOUS VENTILATOR MODES	3
SETTINGS	3
COMMON APPROACH	3
SPECIAL CASES	4

ICU vs. OR Differences

	ICU	OR
Patient Differences	<ul style="list-style-type: none"> - Goal: wean patients off vent - Patients rarely receive NMB or general anesthetic → patients usually awake 	<ul style="list-style-type: none"> - Goal: continue until surgery is over - Usually short ventilation in patients with normal lungs - Patients usually receive NMB and GA → cooperation and synchrony with ventilator is better
Ventilator Differences	<ul style="list-style-type: none"> - Has more modes for awake patients and prolonged weaning 	<ul style="list-style-type: none"> - Less powerful than ICU ventilators → not able to generate same PEEP pressures - In circuit with vaporizers

Basic Modes

- Controlled vs. spontaneous modes
 - **Controlled modes** – machine controls majority; patient may be able to trigger breath
 - **Spontaneous modes** – machine dependent on patient to set respiratory pattern and initiate breaths
- Patient with induced paralysis require controlled modes
- Newer ventilators will revert to controlled mode if patient is apneic on spontaneous modes

Controlled Ventilator Modes

- **Controlled mechanical ventilator** – all breathes controlled by ventilator; patient cannot trigger breaths → uncomfortable for conscious patients
- **Intermittent mandatory ventilation (IMV)** – machine delivers set RR and TV, but patient is able to breathe in-between mandatory breaths
 - Patient initiated breaths are unsupported
- **Synchronized intermittent mandatory ventilation (SIMV)** – machine detects drop in pressure in circuit (pressure trigger) or increased flow (flow trigger) → fully supported breath is given
 - If no breath is detected, machine gives breath at end of window
 - If patient is breathing faster than set rate, breaths above set rate will not be supported
 - Pressure support + SIMV → patient gets support for extra breath
 - Pressure-cycled or volume-cycled set for support
 - Ventilator settings: TV, RR, FiO₂, PEEP
- **Pressure Control Volume Guarantee (PCVG); Adaptive Pressure Control (APC); Pressure Regulated Volume Control (PRCV)** – set desired TV; ventilator adjusts pressure to achieve TV
 - Plateau pressure changes between breaths compared with pressure control

Spontaneous Ventilator Modes

- **Pressure Support Ventilator (PSV)** – most common mode for spontaneous assisted ventilation
 - Machine provides set PEEP and FiO_2 , but patient determines RR, TV, respiratory pattern
 - Flow- or pressure- triggered
 - More comfortable for awake patients → commonly used in ICU
 - Amount of pressure can be titrated to achieve desired TV and MV
 - Uses in OR:
 - Patient is spontaneously breathing (eg. with LMA in place)
 - At end of case when patient is waking up and see negative deflections in ETCO_2 tracing and actual RR > set rate
 - Less commonly used in OR during start or main portion of case
 - Ventilator may switch to mandatory mode if patient is apneic
- **Manual breathing “the bag”** – patient taken off ventilator and take breaths on own
 - No support from ventilator
 - No PEEP unless pop-off valve is slightly closed
 - Patient has added resistance with ETT compared to breathing normally

Settings

- Prevent post-op respiratory complications using:
 - PEEP ~ $5\text{cmH}_2\text{O}$
 - TV $6\text{-}8\text{mL/kg}$ of predicted body weight
 - \pm periodic recruitment maneuvers
 - May cause hypotension (\downarrow preload), pneumothorax, pressure on suture lines
- Low FiO_2 → conflicting evidence
 - See free radicals in exhaled gas ~1 hour after supplementary O_2
 - 100% FiO_2 causes lung inflammation
 - Absorptive atelectasis when O_2 absorbed by blood > CO_2 delivered to alveoli

Common Approach

- Ventilate patient with ventilator set on manual and pop-off valve open
- Set ventilator on mandatory mode once patient is induced and apneic
- Initial settings should be:
 - TV $6\text{-}8\text{mL/kg}$
 - PEEP $\geq 5\text{ cmH}_2\text{O}$; may use 6 to 8 cmH_2O on obese patients
 - RR 12, then adjusted based on ETCO_2
 - I:E may need to be increased to 1:3 in patients with obstructive lung disease
 - Flow-time curve should be coming back to baseline → otherwise, develop dynamic hyperinflation aka. auto-PEEP
 - If can't change I:E ratio, increase flow or decrease RR → need to allow more exhalation time
- Inspiratory TV may not match expiratory TV in the following situations:
 - PCVG → because machine constantly adjusting
 - SIMV → small leaks in system and small amount in gas sampling line
 - If > 50cc, investigate cause

- When notches or extra breaths appear in ETCO₂ tracing, different approaches to take:
 - o Give more paralytics
 - o Increase anesthetic depth
 - o Increase MV → lower CO₂ → inhibits CO₂-mediated respiratory drive
 - o Switch patient to spontaneous mode (eg. pressure support) and let them breath on own
- Patient breathing spontaneously \neq patient is waking up
- At end of case, allow CO₂ to rise by ↓RR → ↑pCO₂ → ↑drive to breath → breathing → switch to pressure support or manual
- Once patient is reversed and on manual ventilation, assess extubation criteria:
 - o Ability to take good tidal volumes of at least 5mL/kg
 - o Maintain normal spO₂, normal ETCO₂
 - o Follow commands
 - o Demonstrate adequate strength (eg. breathing, four twitches with no fade)
 - o No ongoing surgical bleeding
 - o No concern for any acid-base disturbances
- People typically extubate on 100% O₂, may extubate on less to avoid absorptive atelectasis
- For patients with significant lung disease, EtCO₂ may not correlated with pCO₂ → check VBG or ABG to determine gap

Special Cases

- Laparoscopic surgery:
 - o Abdomen insufflated with CO₂ → pressure on diaphragm → ↑ pressure required to push diaphragm down → ↑ PEEP to ~10cmH₂O (if patient euvolemic) to counteract
 - May require very high PEEP → switch to pressure control or pressure control volume guarantee
 - o ETCO₂ may rise as abdomen CO₂ is absorbed → could ↑ RR, but being careful to stop when insufflation is stopped
- Steep Trendelenburg: abdominal organs press up on diaphragm causing similar effect
- Need for one lung ventilation
 - o Accomplished in three ways:
 - Advancing standard ETT into mainstem bronchus
 - Using double lumen ETT
 - Using bronchial blocker
 - o ↓ TV by ~1/3
 - o Pressure cycled modes are harder because no guaranteed TV → easier to use volume control and reduce volume to keep PEEP <30cmH₂O as long as there's adequate oxygenation and ventilation

#Is this how you use ventilators in the OR?
#Are there other special situations that are important?

Comments or suggestions? Please email accrac@accrac.com or leave a comment on the [website](#).
Fan of the show? Please take a moment to leave a comment and a rating to help others find the show!
Want to support the show? Patreon.com/ACCRAC to become a patron and support the making of the show, or donate to paypal.me/ACCRAC
 Notes by [April Liu](#)