LARGE GROUP: VENTILATOR MANAGEMENT 1
Ventilator Graphics, Scalars, Lung Mechanics (ASL 5000 with vent)

Friday, January 18, 2019 – 11:35 a.m. – 12:05

Lance Pangilinan, RRT
UC San Francisco
Adult Critical Care Respiratory Therapist

Lance Pangilinan, RRT, is an Adult Critical Care Respiratory Therapist for the University of California San Francisco, Department of Anesthesia at Zuckerberg San Francisco General Hospital and Trauma Center (ZSFG). There, he currently serves as a bedside therapist and educator. Lance is a lecturer for the Critical Care Residency Program at ZSFG on the topics of Mechanical Ventilation Mechanics and ARDS management. He is a published researcher and has spoken nationally at a number of respiratory and critical care conferences on the subjects of strategic ventilation practices and the use of non-invasive end-tidal monitoring.

Justin Phillips, RRT
UC San Francisco
Adult Critical Care Respiratory Therapist

Justin Phillip, RRT, is an Adult Critical Care Respiratory Therapist for the University of California San Francisco, Department of Anesthesia at Zuckerberg San Francisco General Hospital and Trauma Center (ZSFG). There, he currently serves as a bedside therapist and educator. Justin is a lecturer for the Critical Care Residency Program at ZSFG on the topics of Mechanical Ventilation Mechanics and ARDS management. Additionally, he is Adjunct Faculty for the Respiratory Care Program at Ohlone College for Health Sciences and Technology. Justin is a published researcher and has spoken nationally at a number of respiratory and critical care conferences on the subjects of strategic ventilation practices and the use of non-invasive end-tidal monitoring.

Gregory Burns, RRT
UC San Francisco
Respiratory Care Practitioner

Gregory Burns, RRT, is a Respiratory Care Practitioner for the University of California San Francisco, Department of Anesthesia at Zuckerberg San Francisco General Hospital and Trauma Center (ZSFG). There, he currently serves as interim Equipment Manager. Gregory's research interests include the effect of inhaled vasodilators on patients with the Acute Respiratory Distress Syndrome.

Vivian Yip, BS, RRTACCS
UC San Francisco
Adult and Neonatal Critical Care Respiratory Therapist

Vivian Yip, BS, RRT-ACCS, is a Adult and Neonatal Critical Care Respiratory Therapist for the University of California San Francisco, Department of Anesthesia at Zuckerberg San Francisco General Hospital and Trauma Center (ZSFG). There, she currently serves as a bedside therapist and educator. Vivian is a lecturer for the Critical Care Residency Program at ZSFG on the topics of Mechanical Ventilation Mechanics and ARDS management. Vivian is a published researcher and has spoken at a number of respiratory and critical care conferences on the subjects of spontaneous breathing trials and the impact of THAM in patients with severe acidosis in ARDS.

Rich Kallet, MS, RRT
UC San Francisco
Respiratory Therapist

Rich Kallet, MS, RRT received his baccalaureate degree in respiratory therapy from SUNY Upstate Medical University in Syracuse NY and his masters of sciences degree in health sciences from San Francisco State University. He spent the majority of his 42 year career working for the University of California, San Francisco Department of Anesthesia at San Francisco General Hospital and the UCSF Cardiovascular Research Institute. He was a research coordinator for NIH ARDS Network from 1996-2011 and has worked as a project manager and director of clinical research for the CVRI, the San Francisco Injury Center and both the Critical Care Management Group and the Respiratory Care Services at SFGH. He retired in 2018 and currently is section editor for the Respiratory Care Journal.

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Hospital and Trauma Center

Ventilator Management: Ventilator Graphics, Scalars, & Lung Mechanics

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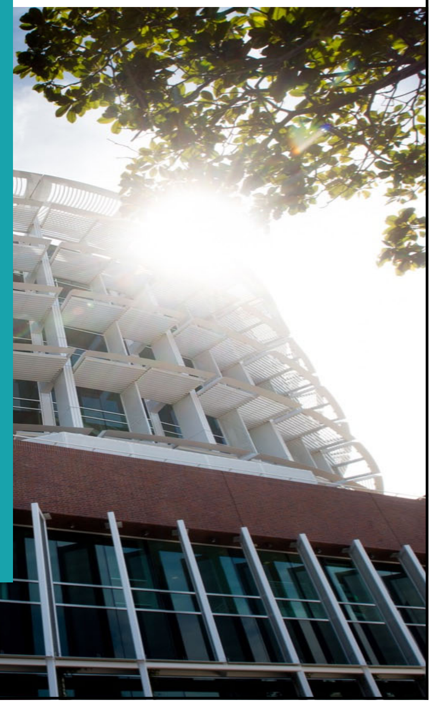
Respiratory Care Services
UCSF Department of Anesthesia
Zuckerberg San Francisco General Hospital & Trauma Center



Disclosure of Conflict of Interest

- We have no relevant financial relationships with commercial interests to disclose

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Overview

- Thirty (30) minute interactive panel discussion integrating live simulated clinical conditions via a high-fidelity lung model to a live audience
- Primary objectives include detailed discussion on Work of Breathing (WOB) and the intricacies of imposed work in various modes of mechanical ventilation

Overview

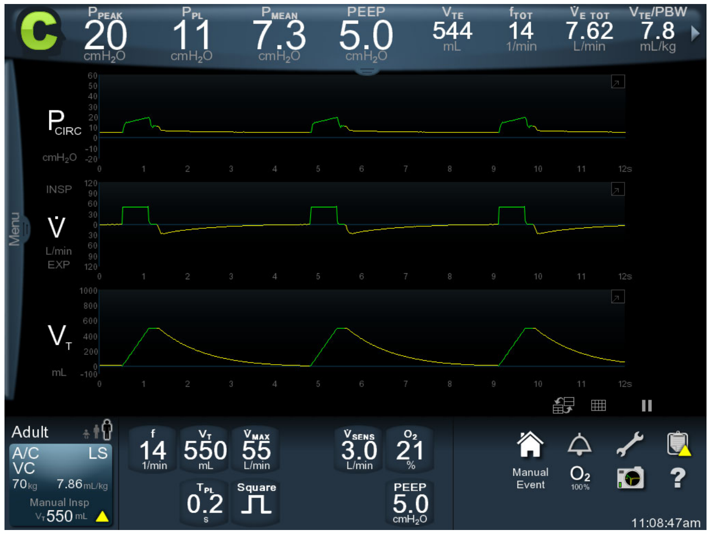
- Introduction to Scalars
- Partial vs. Full Support and WOB
- Clinical Conditions and WOB
- WOB Under Muscle Loading
- Adaptive Pressure Control (APC)

Introduction to Scalars

Introduction to Scalars

- Review of graphical layout of scalars
- The representation of time and…
  - Pressure
  - Flow
  - Volume

Introduction to Scalars



Partial vs. Full Support & WOB

Respiratory muscle loads

- Three (3) loads
  - Resistive
  - Elastic
  - Threshold
    - Zero flow or chest displacement with diaphragm contraction secondary to intrinsic PEEP or trigger sensitivity threshold
- "Push-pull"
  - Ventilator and patient work
    - Force x Distance **or** Pressure x Volume
    - Reduces patient WOB

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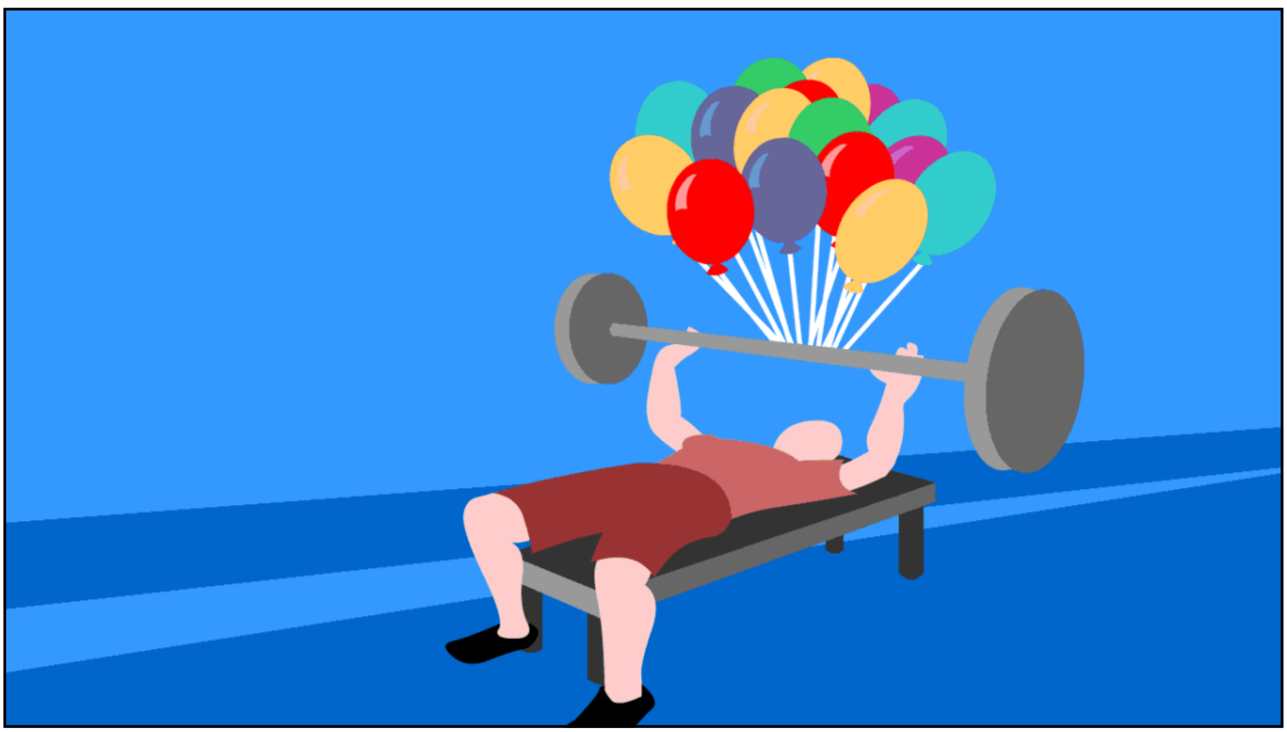


Partial vs. Full Support & WOB: Issues with Spontaneous Breathing

- Satisfying patient demand
  - Time Intervals
    - Breath initiation and termination
- Clinician interpretation of V_T as an indicator for adequate support
  - The ability of PCV to lower patient WOB depends upon PC level
- Preservation of minute ventilation
  - Determines effort (P_{MUS})

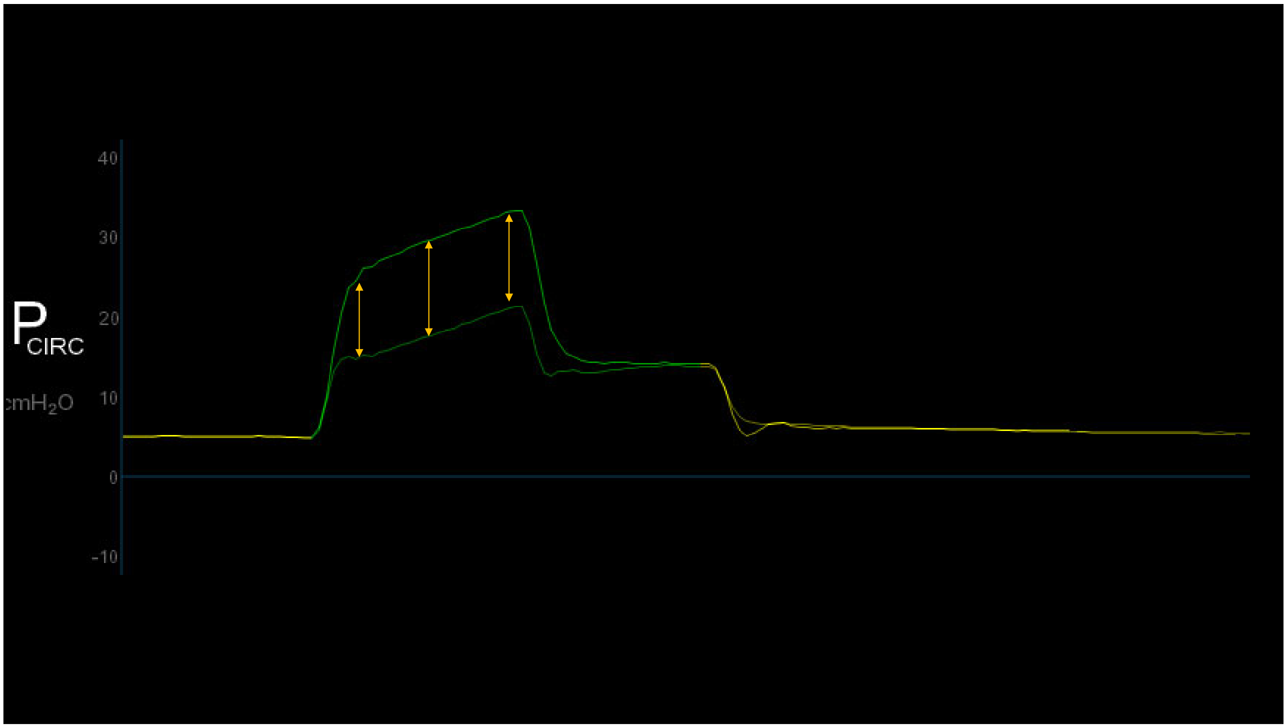
Partial vs. Full Support & WOB

- **Model One**
  1. Apnea
  2. Low work
  - A minimum mandatory rate that can be increased to augment V_E
    - Every breath controlled in terms of a fixed T_{INSP}
  - Partial support of minute ventilation demand
    - Uses patient's respiratory muscles to provide most of the power of breathing

Clinical Conditions and WOB

Clinical Conditions and WOB

- **Model Two: Volume Control**
  1. Low work
  2. High resistance
- **Teaching Point**
  - Circuit pressure is work required for ventilator to deliver set volume & flow



Clinical Conditions and WOB

- **Model Three: Volume Control**
  1. Low work
  2. Low compliance, high elastance
- **Teaching Point**
  - Circuit pressure is work required for ventilator to deliver set volume & flow

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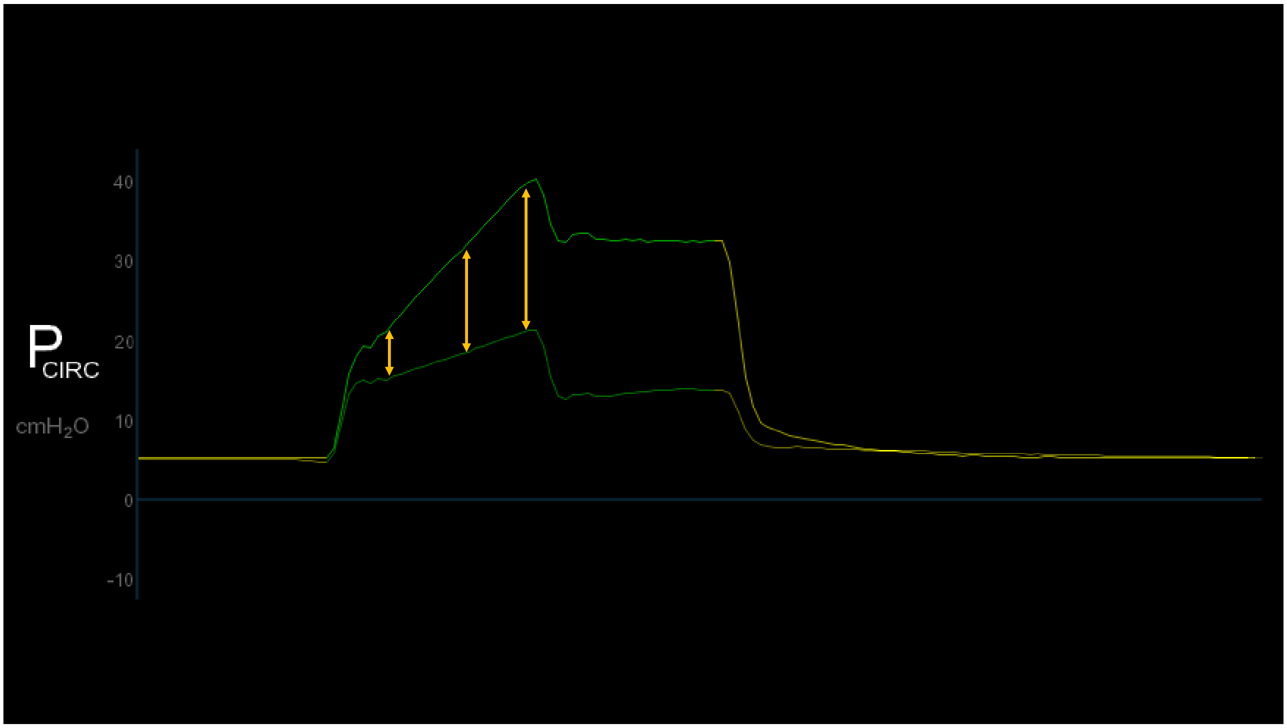
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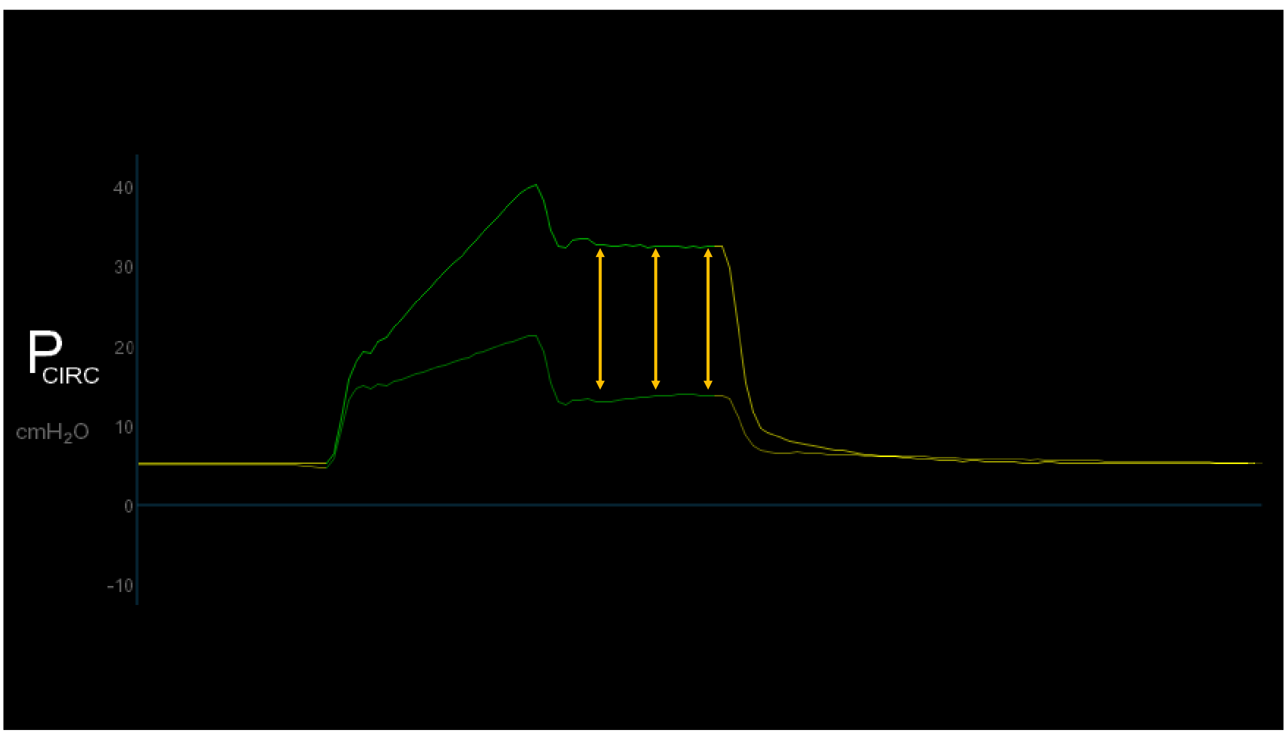
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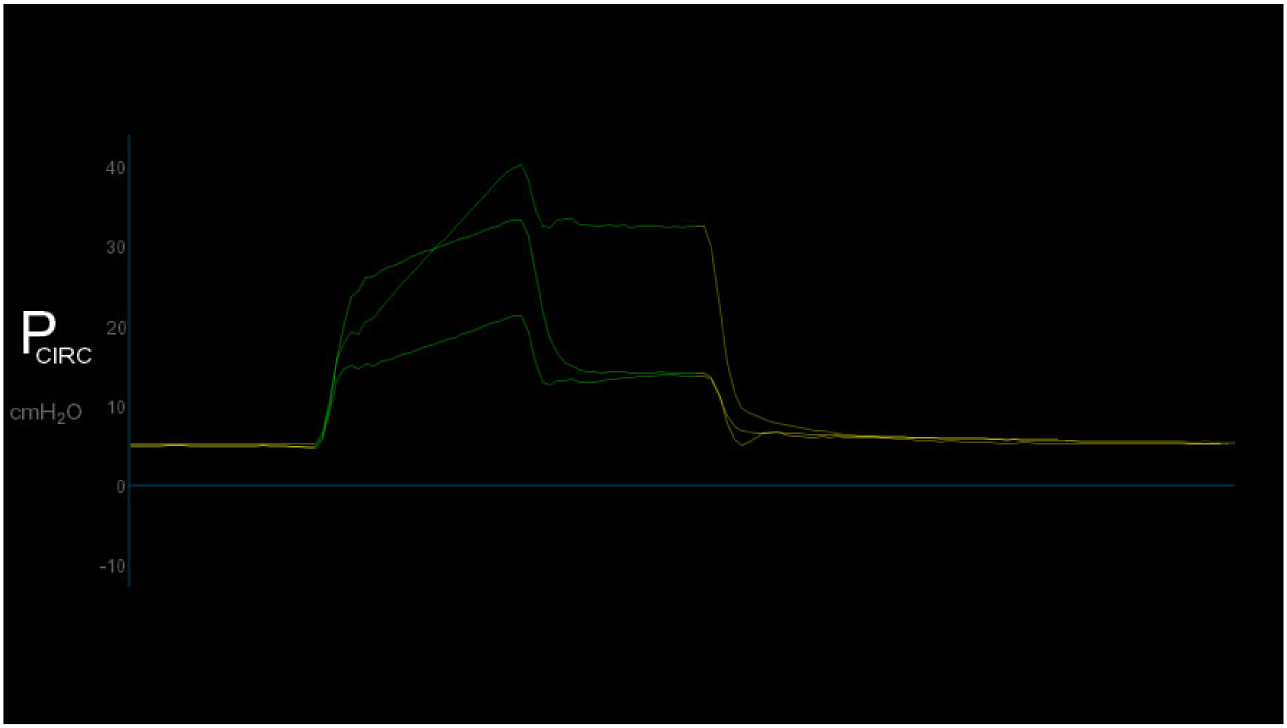

WOB Under Muscle Loading

WOB Under Muscle Loading

- **Model Four: Volume Control**
  1. High work
  2. Low compliance, high elastance
- **Teaching Point**
  - Circuit pressure decrease reflects elevated patient work

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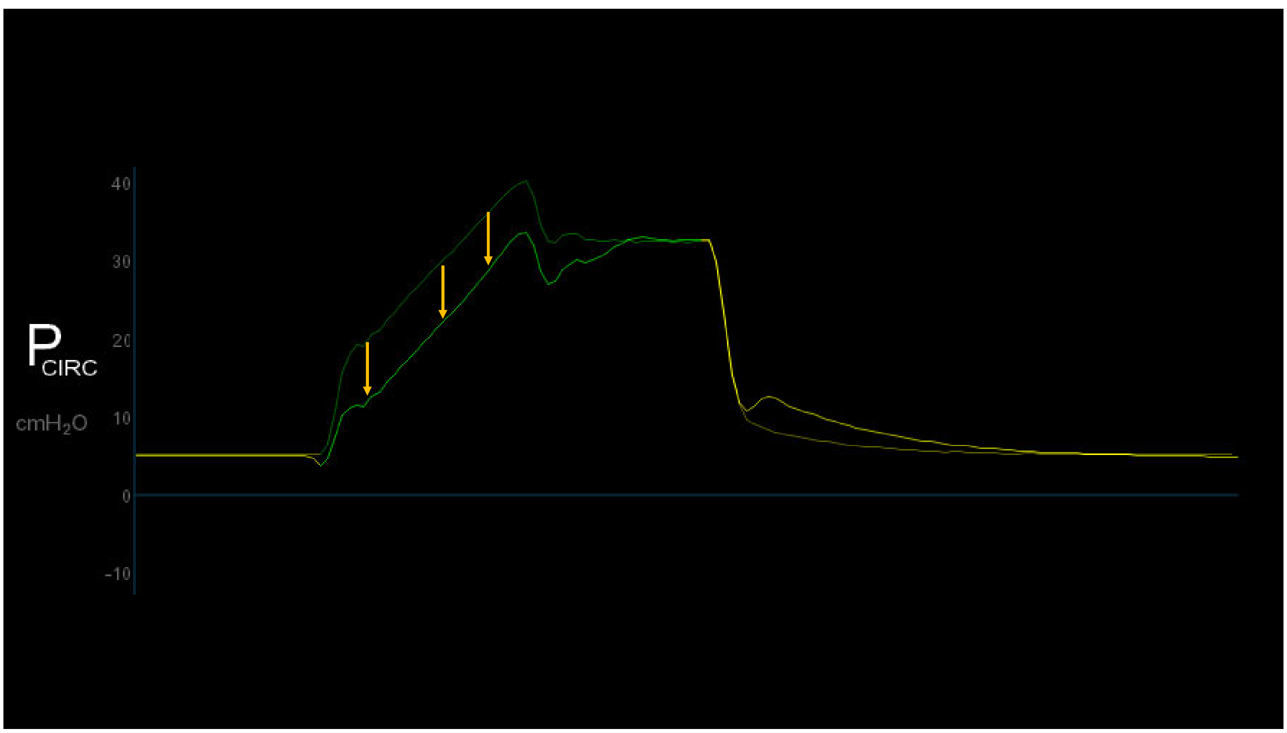
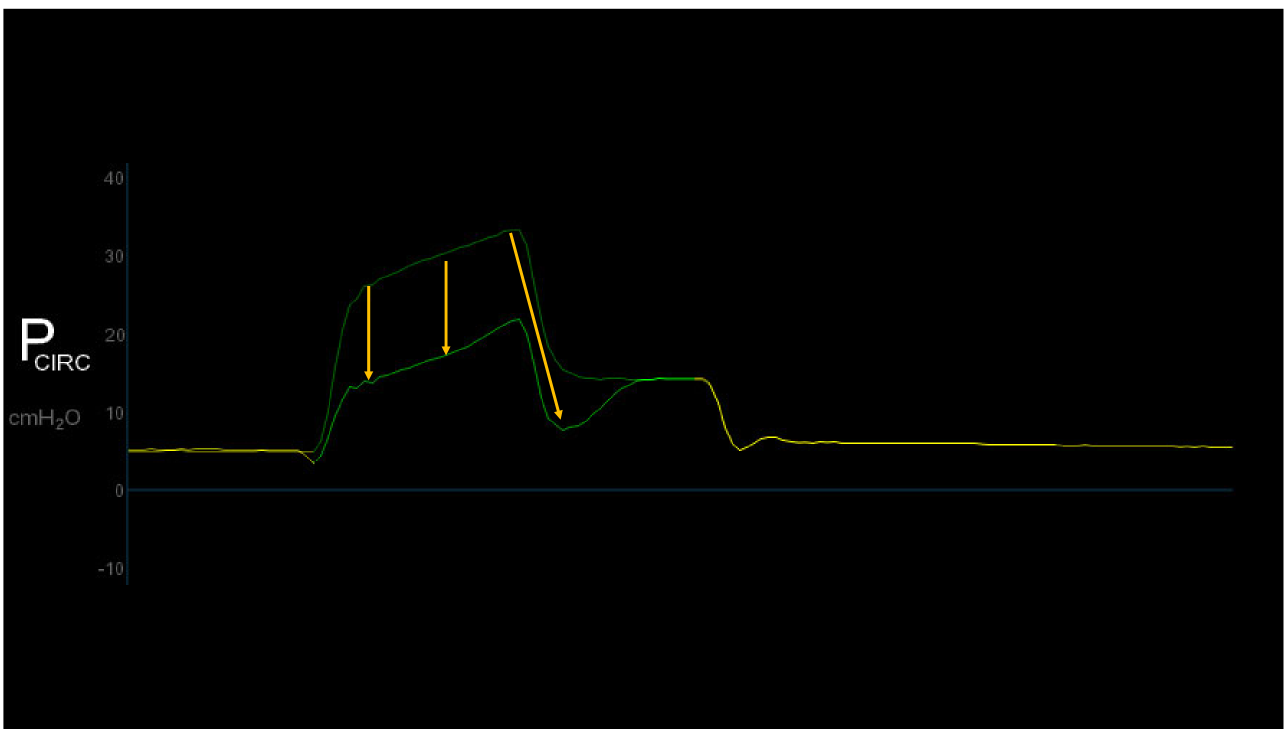


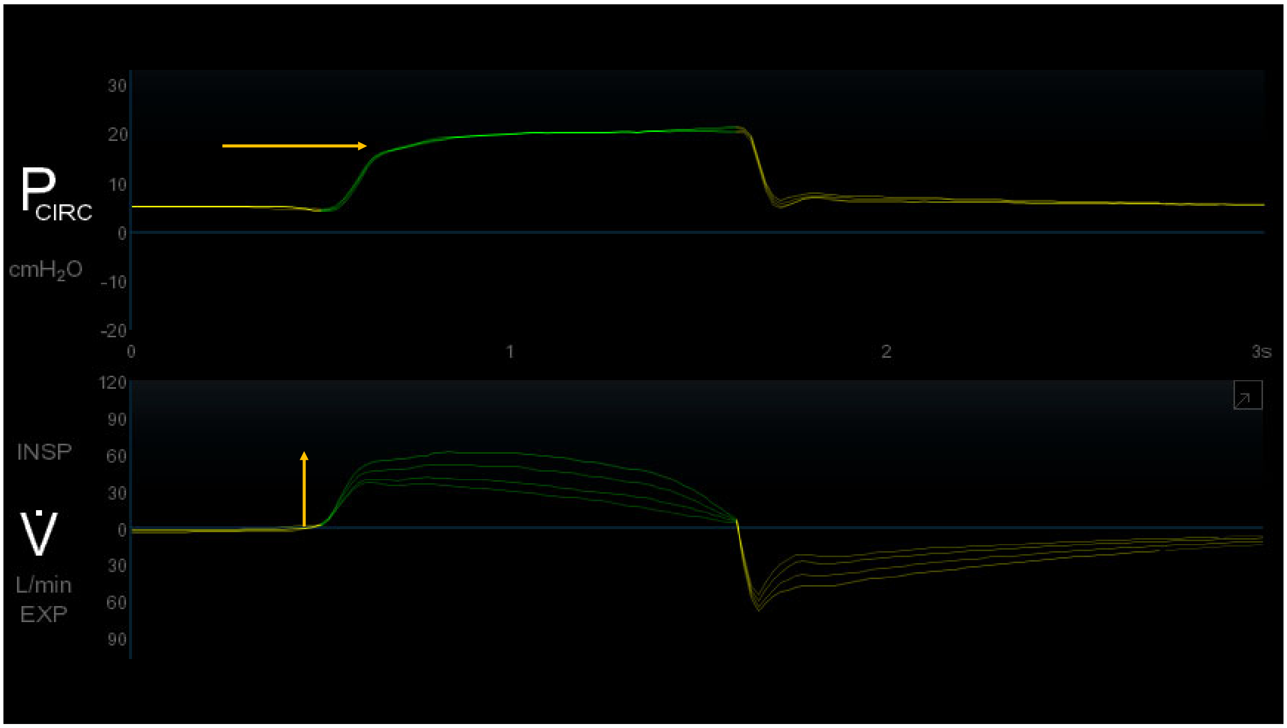
WOB Under Muscle Loading

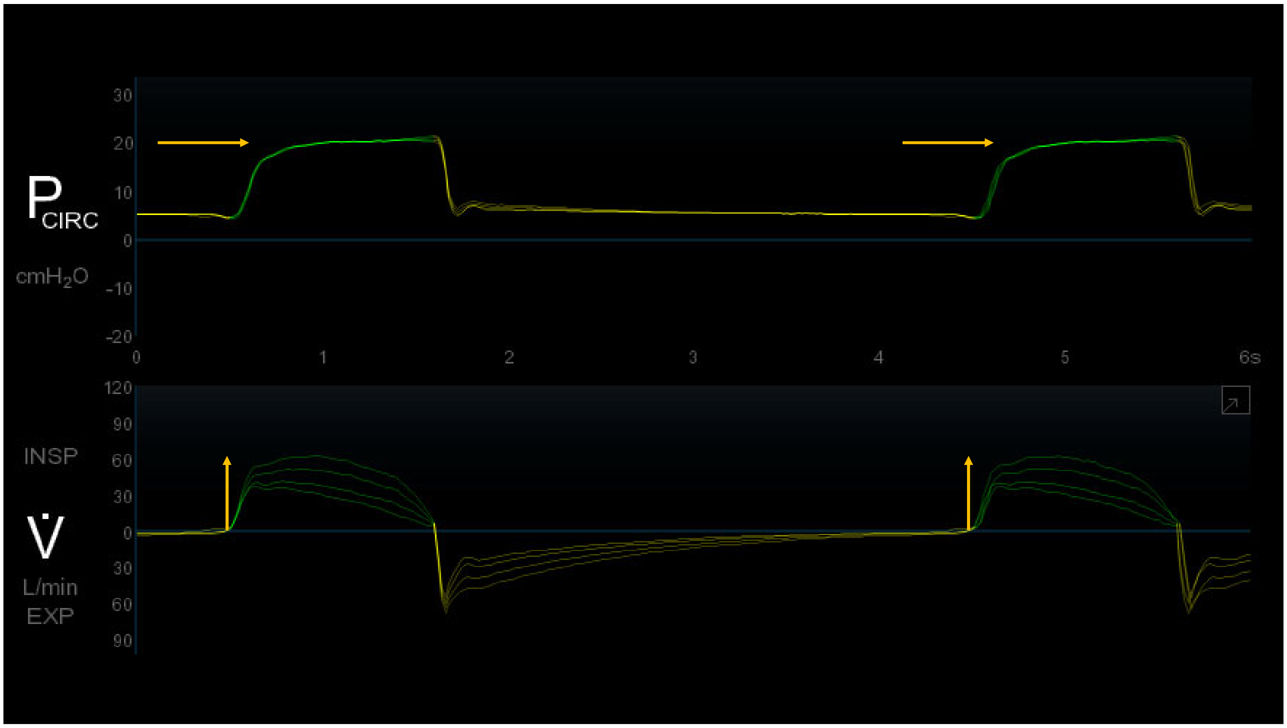
- **Model Five: Volume Control**
  1. High work
  2. Normal compliance, high resistance
- **Teaching Point**
  - Circuit pressure decrease reflects elevated patient work



WOB Under Muscle Loading

- **Model Six: Pressure Control**
  1. High work
  2. Low compliance, high elastance
  3. High resistance
- **Teaching Point**
  - Volume and flow change is dependent on patient work
  - To modify tidal volume, "ventilator work" (PIP) needs to be adjusted (↑ or ↓)

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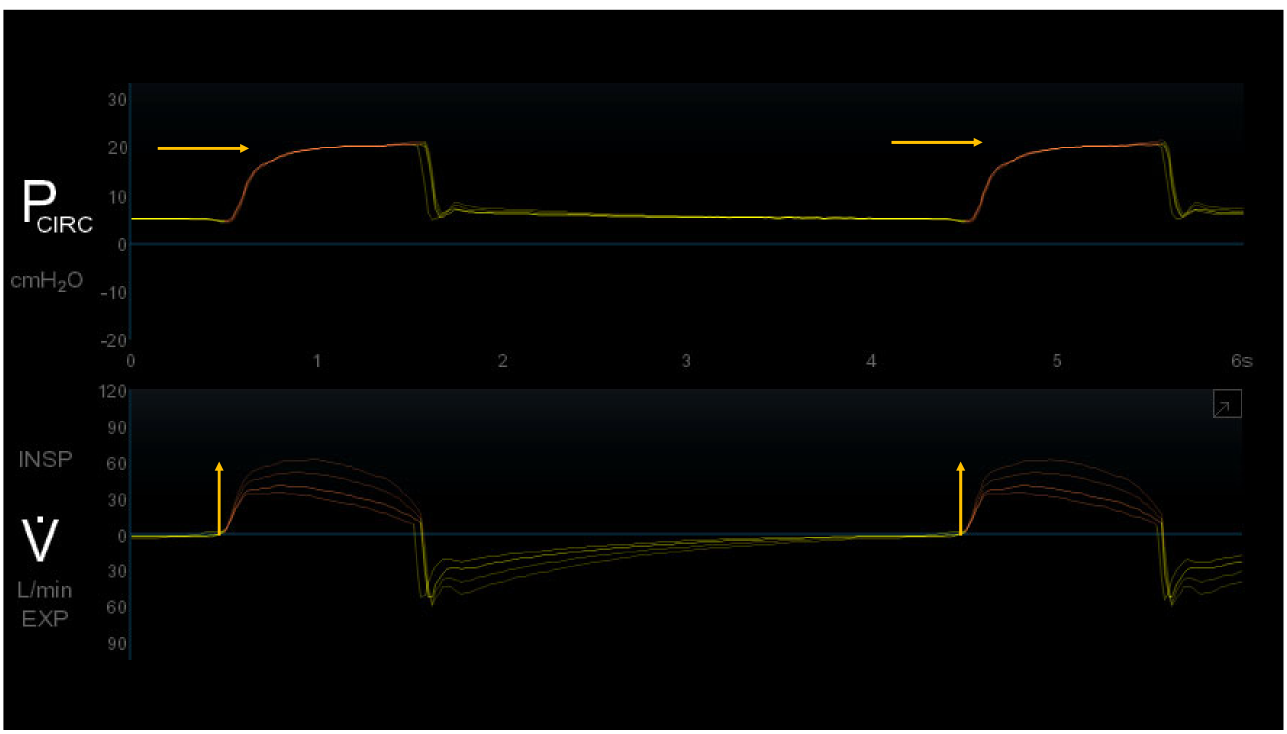
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Adaptive Pressure Control (APC) Review

Adaptive Pressure Control (APC)

- APC is…
  - Pressure Regulated Volume Control (PRVC, Maquet & Vyaire Medical)
  - Auto-Flow (VC/AF, Dräger Medical)
  - Volume Control Plus (VC+, Puritan Bennett)
- **Teaching Points**
  - Underestimating/inappropriate level of support in APC
  - Application and interpretation of APC waveforms
  - APC in low vs. high patient effort
    - Effect on airway pressures (peak inspiratory and mean airway pressures)
      - What does this mean in the setting of lung injury?

Adaptive Pressure Control (APC)

- **Model Seven: Adaptive Pressure Control**
  - Benefits of APC
    - Illusion of "extra" lung protection
  - As ventilator attempts to maintain desired tidal volume, ventilator WOB decreases as P_{MUS} increases
    - Decrease in ventilator work output shifts WOB to patient

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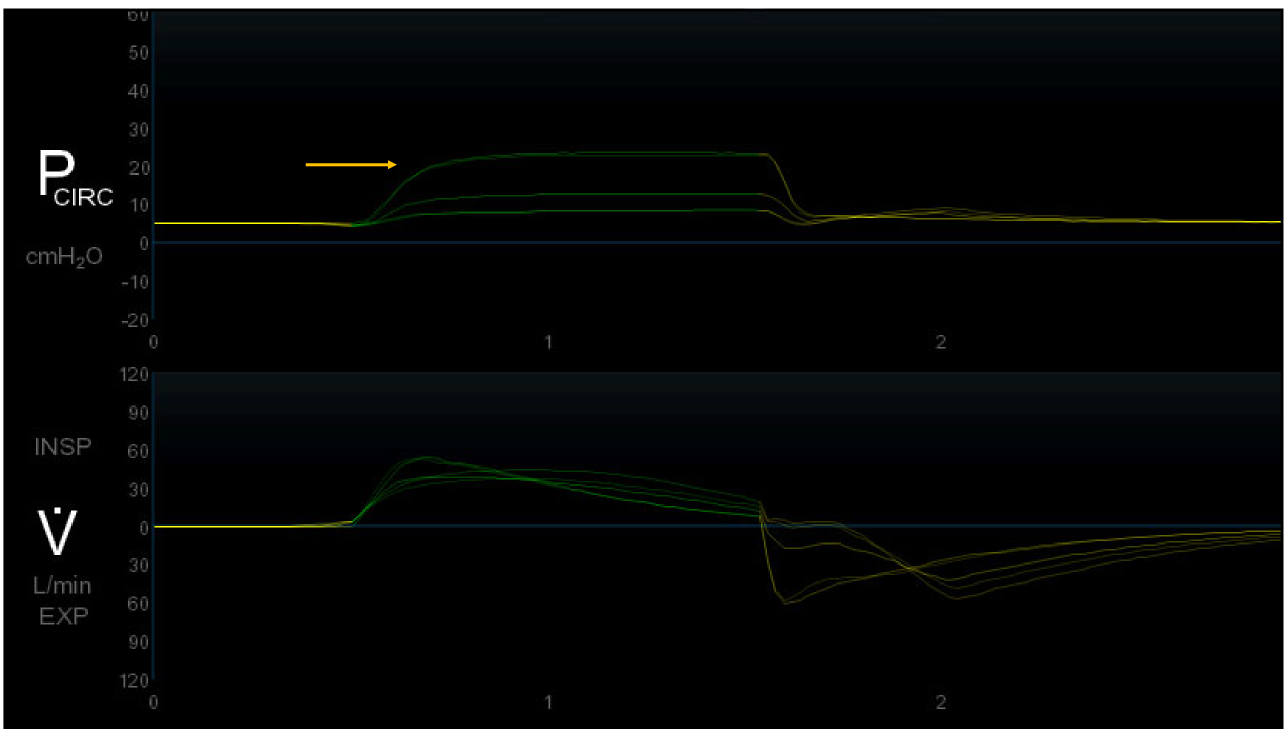

Summary

- Respiratory mechanics are best assessed in static conditions while using a volume targeted mode with constant flow
- Patient effort effects the patient-ventilator pressure dynamic
  - May effect ability to accurately interpret respiratory mechanics
- Closed loop modes (i.e. APC) of mechanical ventilation can assist the clinician under ideal circumstances; however, unwanted results may occur in certain clinical conditions

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