

Initiation & Management of Mechanical Ventilation Live Broadcast

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This Presentation is Approved for
1 CRCE Credit Hour

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Learning Objectives

- Identify reasons for initiation of mechanical ventilation.
- Describe intubation techniques.
- Explain mechanical ventilation management strategies .
- Discuss patient monitoring.
- Describe a spontaneous breathing trial.
- Recommending extubation vs. tracheostomy.

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Reasons to Intubate

- **Respiratory Failure**
- **Disordered Control of Breathing**
- **Airway protection**
- **Airway obstruction**
- **Therapeutics**
- **Hemodynamic instability**

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Respiratory Failure

- **Just can't breathe enough**

$$PAO_2 = FIO_2 (P_{ATM} - P_{H_2O}) - PaCO_2/RQ$$

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Respiratory Failure

> Just can't breathe enough

$$PAO_2 = FiO_2 (P_{ATM} - P_{H_2O}) - PaCO_2/RQ$$

$$PAO_2 = .21 (760 - 47) - 40 * 1.25$$

$$PAO_2 = .21 (713) - 40 * 1.25$$

$$PAO_2 = 150 - 50$$

$$PAO_2 = 100$$

$$PaO_2 = 95$$

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Respiratory Failure

> pCO₂ = 50

$$PAO_2 = FiO_2 (P_{ATM} - P_{H_2O}) - PaCO_2/RQ$$

$$PAO_2 = 150 - (50 * 1.25)$$

$$PAO_2 = 150 - 62.5$$

$$PAO_2 = 87.5$$

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Respiratory Failure

- $p\text{CO}_2 = 50$ $p\text{O}_2 = 82.5$
- $p\text{CO}_2 = 60$ $p\text{O}_2 = 75$
- $p\text{CO}_2 = 70$ $p\text{O}_2 = 62.5$

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Disordered Control of Breathing

- Failure of instruction to breathe

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Airway Protection

- **Aspiration**

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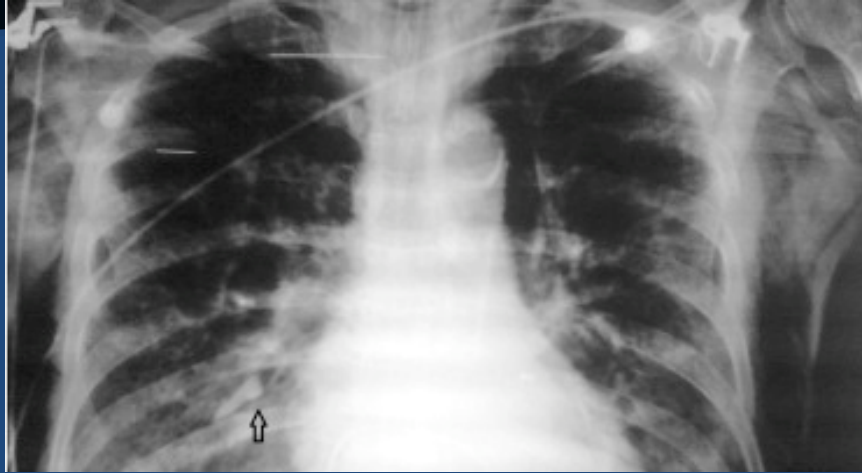
Airway Obstruction

- **Airway securement**
- **Foreign body aspiration**

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Tooth Aspiration



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Therapeutics

- Tracheal suctioning
- Bronchoscopy
- Lung lavage
- Biopsy

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Hemodynamic Instability

- Shock

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Advanced Directives

- Do Not Resuscitate
- Do Not Intubate

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Intubation

- **BVM – PEEP valve**
 - Oral or nasal airway
- **Airway tray**
 - Suction
 - ETT / syringe
 - Stylet
 - Laryngoscope
 - Mac
 - Miller
 - Video assisted
 - Bougie or Airway exchanger
 - Magill forceps – nasal intubation
 - End-tidal CO₂
 - CXR

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Airway Tray

Basic Adult Airway Tray



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Cook Airway Exchanger



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Magill Forceps



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Colorimetric CO2 Detector



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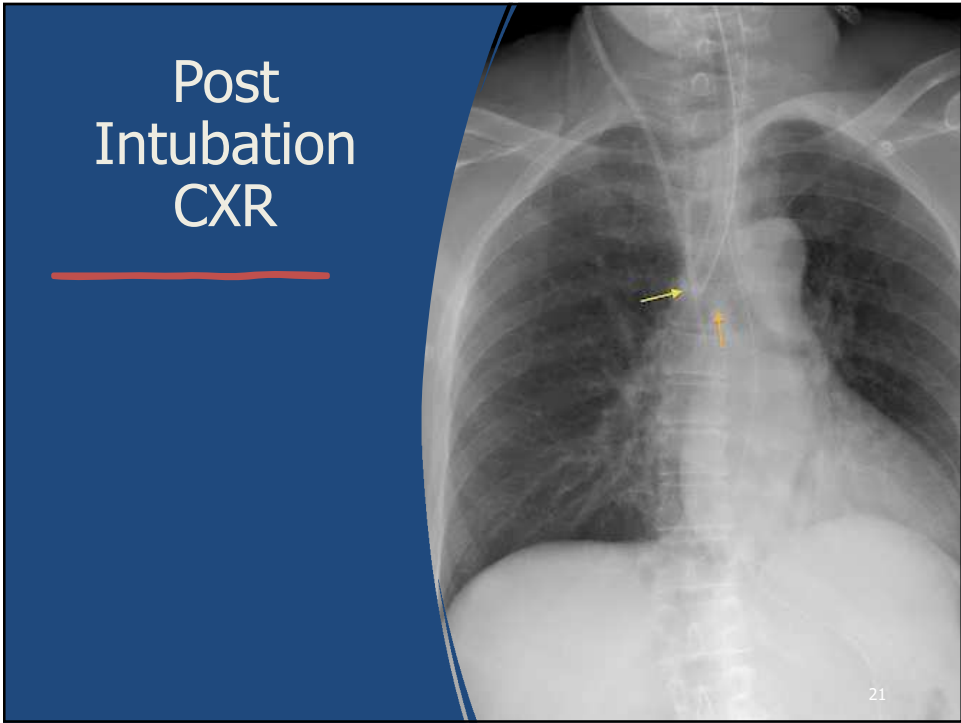
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Hazards of Intubation

- Dental Trauma
- Aspiration
- Laryngeal injuries
- Esophageal intubation

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Initial Settings

- AC-VC or equivalent
- 4-8 ml/kg IBW
- Rate 10-16
- Flow 40-60 lpm
- FiO₂ 40-60% (maybe 100%)
- PEEP – depends, but probably 8-10.

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IBW Calculation kg

- Male $50 + (2.3 \times \text{inches above } 60)$
- Female $45.5 + (2.3 \times \text{inches above } 60)$

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Generic VT Settings

- Male 450
- Female 385

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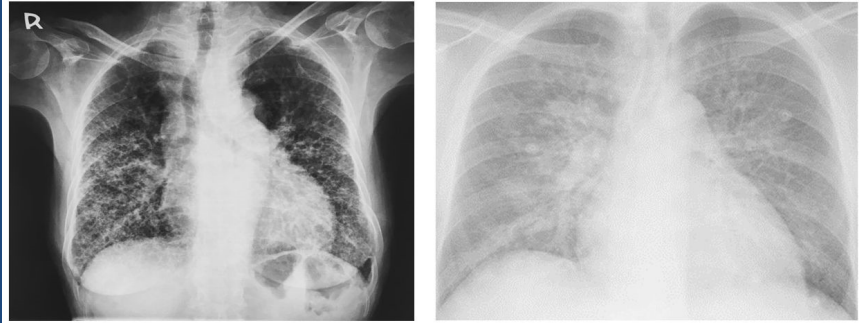
Initial Settings

- Male Rate 14 VT 450 PEEP 8 FiO₂ 40-50%
- Female Rate 14 VT 385 PEEP 8 FiO₂ 40-50%

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Initial Settings



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Initial Settings

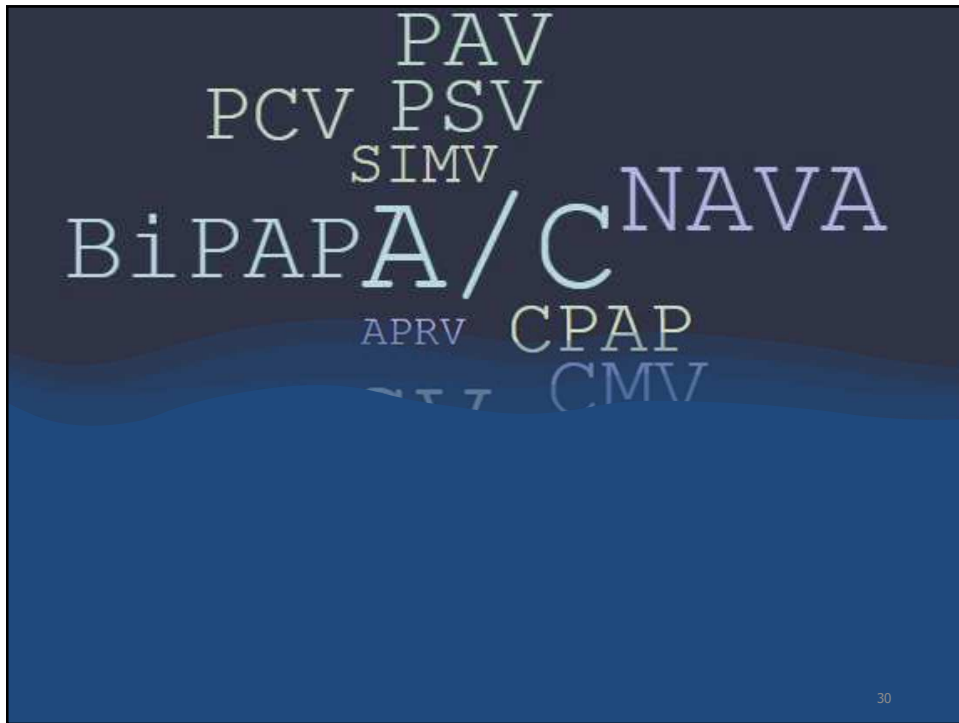


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Ventilation Modes

- **Volume-Controlled Modes**

- AC
- SIMV
- CMV

- **Pressure-Controlled Modes**

- PCV
- APRV

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Ventilation Modes

- **Dual Controlled Modes**

- PRVC
- ASV

- **Spontaneous**

- PSV
- PAV

- **Other**

- NAVA

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Ventilator Alarms

- **High Pressure**
- **Low Pressure**
- **High Ve**
- **Low Ve**
- **High VT**
- **Low VT**
- **Apnea**

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Ventilator Alarms - 980

- **High Pressure**
- **F Total**
- **Ve Total – high/low**
- **VT Mandatory - high/low**
- **VT Spontaneous - high/low**
- **Apnea**

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Ensure Proper Ventilator Management

- Ensure adequate ventilation
- Ensure proper oxygenation
- Protect the lung
- Are we satisfying the patient's neural drive to breathe?
- Is the patient getting better or worse?

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Adjustments

Adjust	Adjust mode as necessary
↓	
Fix	Fix asynchronies

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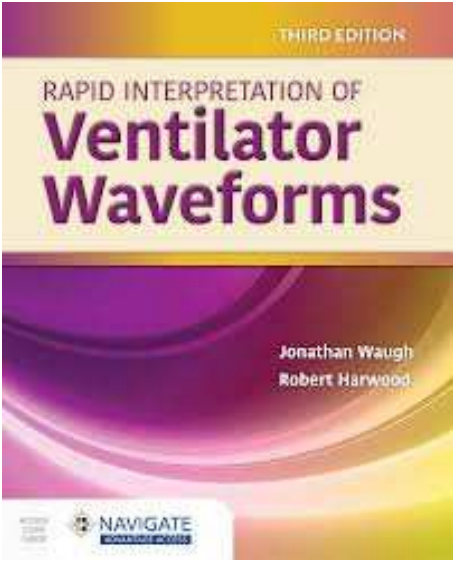


The screenshot displays the INTELIVENT ventilator interface for a patient. The top bar shows the date and time as 2019-01-15 12:03:07. The patient's name is (S)CMV Adult. The interface includes tabs for Patient, Additions, and Modes. On the left, a list of parameters is shown: Ppeak at 23 cmH2O, Pmean at 14 cmH2O, FTtotal at 34 b/min, VTE at 294 ml, and ExpMinVol at 13.2 V/min. The right side features the IntelliCuff control panel with settings for Rate (14 b/min), Volume (400 ml), and Pressure (10 cmH2O). The central area contains three waveforms: Paw (cmH2O) showing pressure over time, Flow (l/min) showing tidal volume breaths, and V (ml) showing volume over time.

Common Asynchronies

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The image shows the cover of the book 'Rapid Interpretation of Ventilator Waveforms', Third Edition. The authors are Jonathan Waugh and Robert Harwood. The cover features a colorful abstract design with purple and yellow waves. The title is prominently displayed in the center. The book is published by Elsevier and is part of the NAVIGATE Evidence-Based series.

Great Resource

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Adjustments

Check	Check Peak Pressure
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Adjustments

Check	Check Plateau pressure < 30
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Check	Total PEEP
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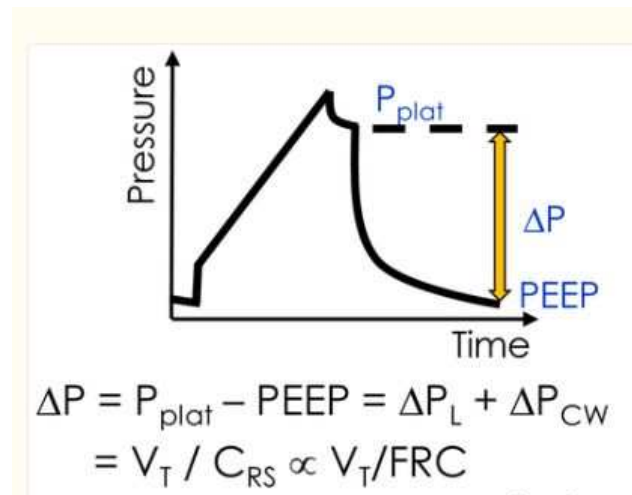
Adjustments

Check

Check driving pressure < 15

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$$\text{Driving pressure} \times C_{RS} = V_T$$

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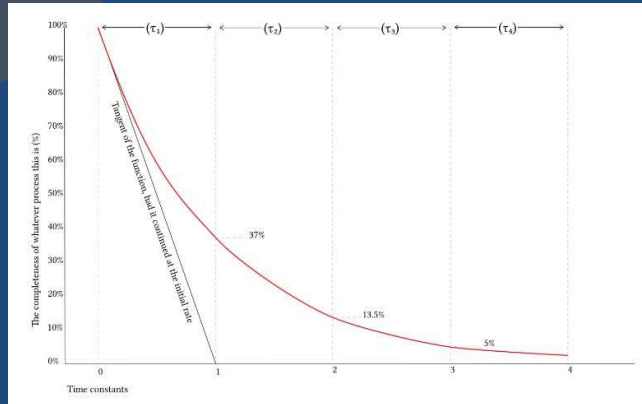
Fixing Driving Pressure

- Lower the Plateau – lower the tidal volume
- Increase PEEP

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Expiratory Time Constant



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Adjustments

Optimize	Optimize PEEP
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Adjustments

Optimize	Optimize PEEP - Decremental
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Adjustments

Optimize	Optimize PEEP - Incremental
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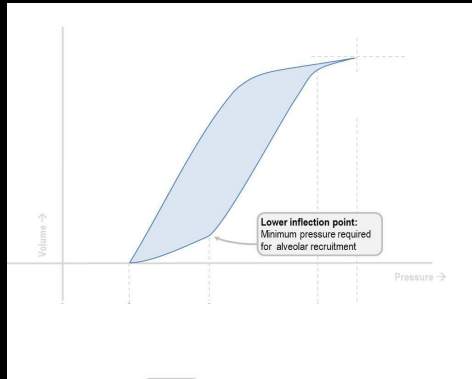
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Adjustments

Optimize

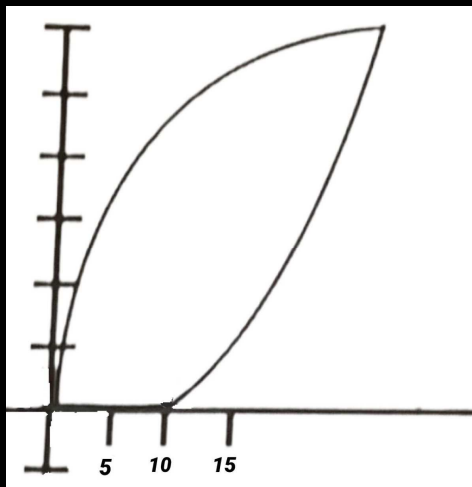
Optimize PEEP – P-V Loop



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P-V Loop



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Adjustments

Optimize Optimize PEEP – SAT

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THE VENTILATOR BOOK

Third Edition

William Owens, MD

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Adjustments

Titrate	Oxygen
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Minor Adjustments

Check	Rise time
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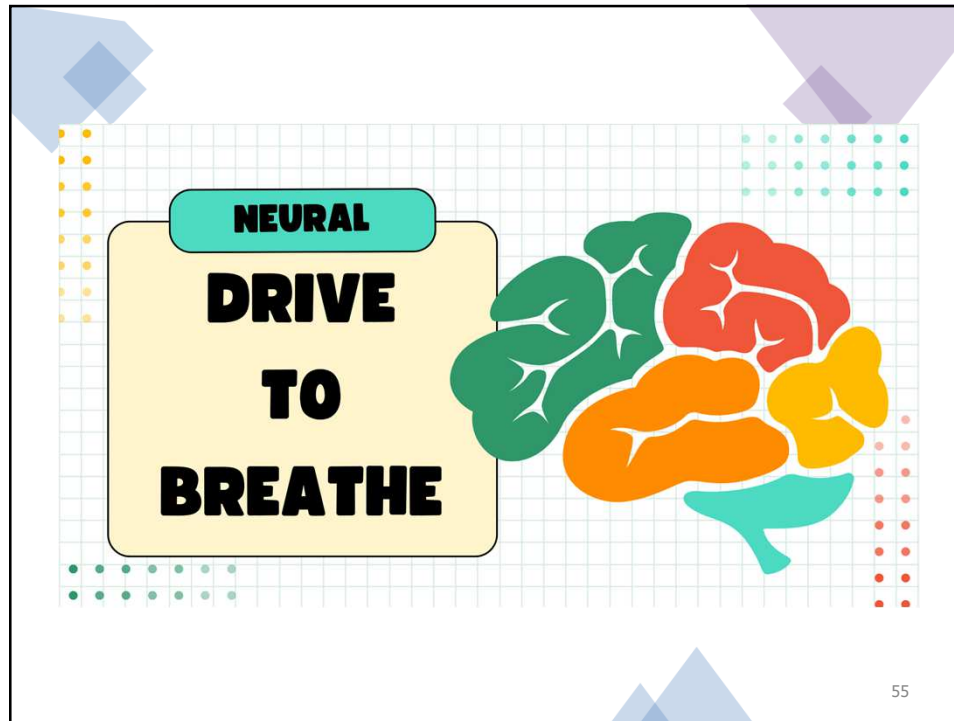
Check	Expiratory Trigger/Flow Cycle
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Check	Sensitivity
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Check for updates

ORIGINAL ARTICLE

Airway Occlusion Pressure As an Estimate of Respiratory Drive and Inspiratory Effort during Assisted Ventilation

Irene Telias^{1,2,3}, Detajin Junhasavasdikul^{1,2,4}, Nuttapol Rittayamaj^{1,2,5}, Lise Piquilloud⁶, Lu Chen^{1,2}, Niall D. Ferguson^{1,3,7,8}, Ewan C. Goligher^{1,3,8}, and Laurent Brochard^{1,2*}

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Abstract

Rationale: Monitoring and controlling respiratory drive and effort may help to minimize lung and diaphragm injury. Airway occlusion pressure (P0.1) is a noninvasive measure of respiratory drive.

Objectives: To determine 1) the validity of “ventilator” P0.1 (P0.1vent) displayed on the screen as a measure of drive, 2) the ability of P0.1 to detect potentially injurious levels of effort, and 3) how P0.1vent displayed by different ventilators compares to a “reference” P0.1 (P0.1ref) measured from airway pressure recording during an occlusion.

Methods: Analysis of three studies in patients, one in healthy subjects, under assisted ventilation, and a bench study with six ventilators. P0.1vent was validated against measures of drive (electrical activity of the diaphragm and muscular pressure over time) and P0.1ref. Performance of P0.1ref and P0.1vent to detect predefined potentially injurious effort was tested using derivation and validation datasets using esophageal pressure–time product as the reference standard.

Measurements and Main Results: P0.1vent correlated well with measures of drive and with the esophageal pressure–time product (within-subjects $R^2 = 0.8$). P0.1ref >3.5 cm H₂O was 80% sensitive and 77% specific for detecting high effort (≥ 200 cm H₂O · s · min⁻¹); P0.1ref ≤ 1.0 cm H₂O was 100% sensitive and 92% specific for low effort (≤ 50 cm H₂O · s · min⁻¹). The area under the receiver operating characteristics curve for P0.1vent to detect potentially high and low effort were 0.81 and 0.92, respectively. Bench experiments showed a low mean bias for P0.1vent compared with P0.1ref for most ventilators but precision varied; in patients, precision was lower. Ventilators estimating P0.1vent without occlusions could underestimate P0.1ref.

Conclusions: P0.1 is a reliable bedside tool to assess respiratory drive and detect potentially injurious inspiratory effort.

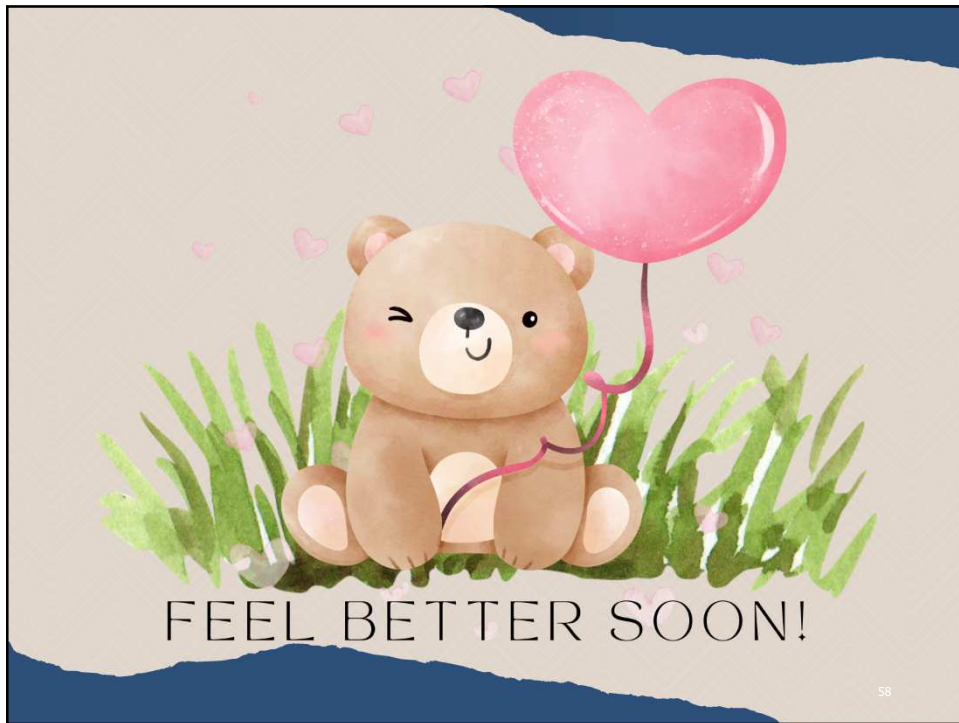
Keywords: artificial respiration; airway occlusion pressure; P0.1; myotrauma; diaphragm

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Troubleshooting

Tube placement

Alkalosis

Blood pressure / cardiac output

C(a-v)O₂

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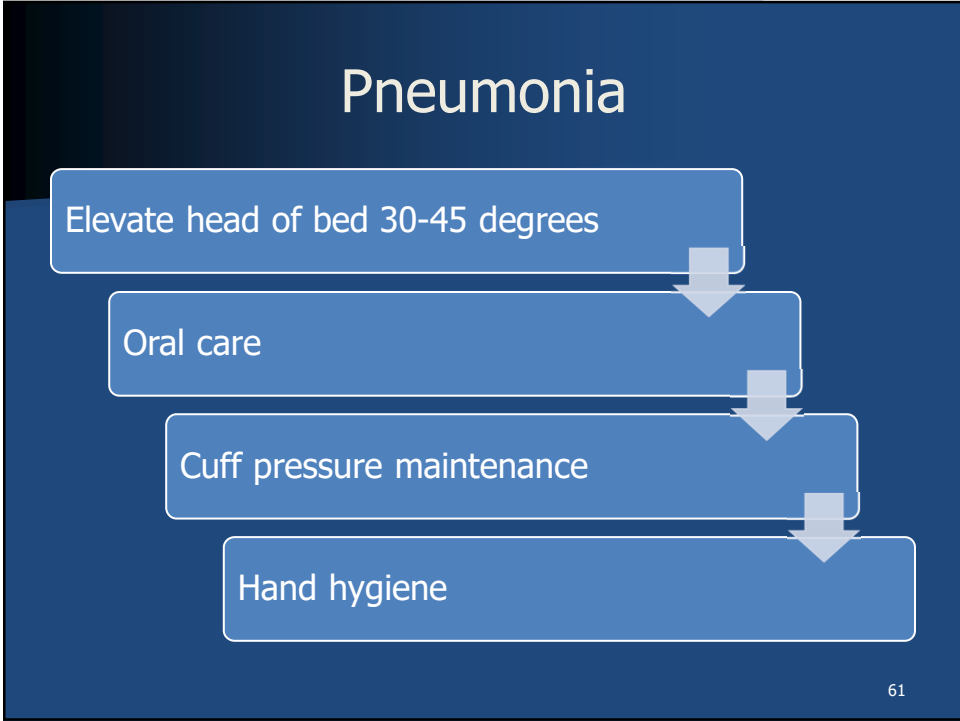
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Troubleshooting

Pneumothorax

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Pneumonia

Subglottic secretion drainage

Minimal sedation

Daily SBT

VAP bundles & protocols

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VAP Protocols

1. Checklists
2. Multidisciplinary teams
3. Compliance audits
4. Educate staff

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VAP Protocols

1. Head of Bed Elevation
2. Daily Sedation Interruption & Assessment for Extubation
3. Peptic Ulcer Disease (PUD) Prophylaxis
4. Deep Vein Thrombosis (DVT)
5. Oral Care

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VAP Protocols

- 1. Subglottic Secretion**
- 2. Hand Hygiene**
- 3. Closed Suction Systems**
- 4. Ventilator Circuit Management**
- 5. Maintain Proper Cuff Pressure**

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Pneumonia

Bug and the drug

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Get Up and Get Out!

Mobility

PT

Nutrition

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Monitoring

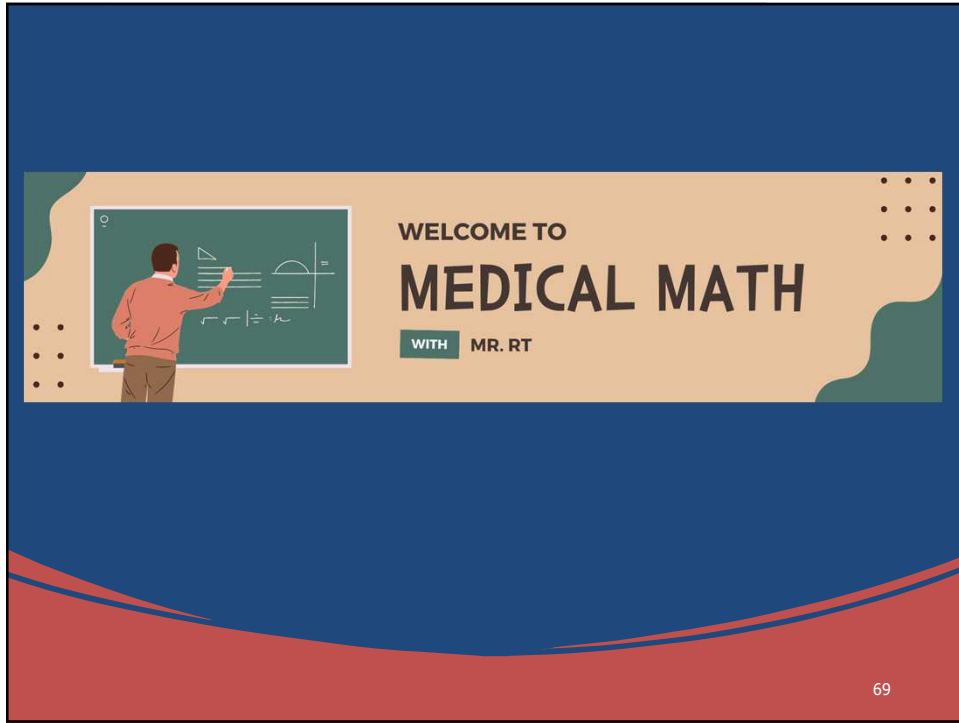
ABG

PETCO₂

Oxygen

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Oxygenation

$$\text{Estimated FiO}_2 = \frac{\text{Future PO}_2}{\text{Current p/f ratio}}$$

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Medical Math

$$(\text{current}) V_e \times \text{CO}_2 = V_e \times \text{CO}_2 (\text{future})$$

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Medical Math

$$RR \times CO_2 = RR \times CO_2$$

or

$$VT \times CO_2 = VT \times CO_2$$

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Medical Math

$$pH \ 0.1 = 12 \ pCO_2$$

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Medical Math

pH = 7.25
pCO₂ = 57

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ANALYZING & INTERPRETING ARTERIAL BLOOD GASES



Keith Varnes, RRT-NPS,
RRT-ACCS, AE-C

This Presentation is
AARC Approved for 1.5
CRCE Credit Hours

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Assess Readiness to Wean (Daily Screen)

- Improved underlying cause
- Hemodynamically stable
- Spontaneously breathing
- $FiO_2 \leq .50$
- $PEEP \leq 8$
- $SpO_2 \geq 90\%$
- $pH \geq 7.30$
- Minimal sedation

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Perform Spontaneous Breathing Trial (SBT)

- T-piece Trial
- CPAP 5 cm H₂O
- PSV 5-8 cmH₂O PEEP 5 cmH₂O
- PSV 5-8 with PEEP 0
- PSV 0 PEEP 0

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Monitor During SBT

- RR > 35/min for > 5 min
- SAT < 90% in $\text{FiO}_2 \leq .50$
- HR > 140 or increase > 20%
- BP increase or decreases > 20%
- Increased WOB

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Evaluate

- RSBI
- Secretions
- Awake and alert/following commands
- MIP/NIF > -20
- P0.1
- Cough/gag
- VC > 10 ml/kg IBW
- Leak > 15%

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Evaluate

- Leak test > 15%
- $500 - 300 = 200$
- $200 / 500 = .40$

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Extubate

- Be ready

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Trach

- 7-10 days

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Report

Give a
good report

What's the
plan?

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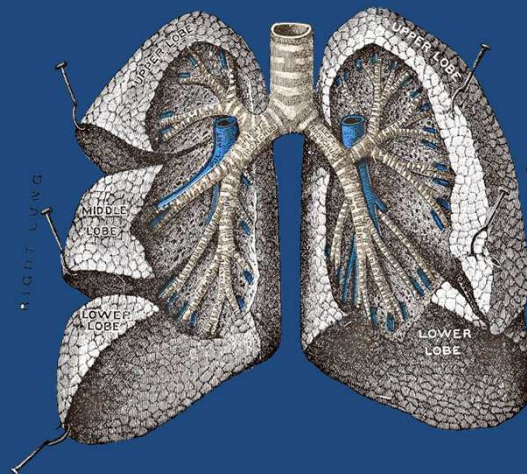
Report

1. Vent settings and mode
2. Alarms and waveforms
3. ABG
4. Airway status
5. Patient synchrony
6. Neuro and weaning
7. Clinical context
8. VAP prevention
9. What's the Plan?!

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Summary & Review



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