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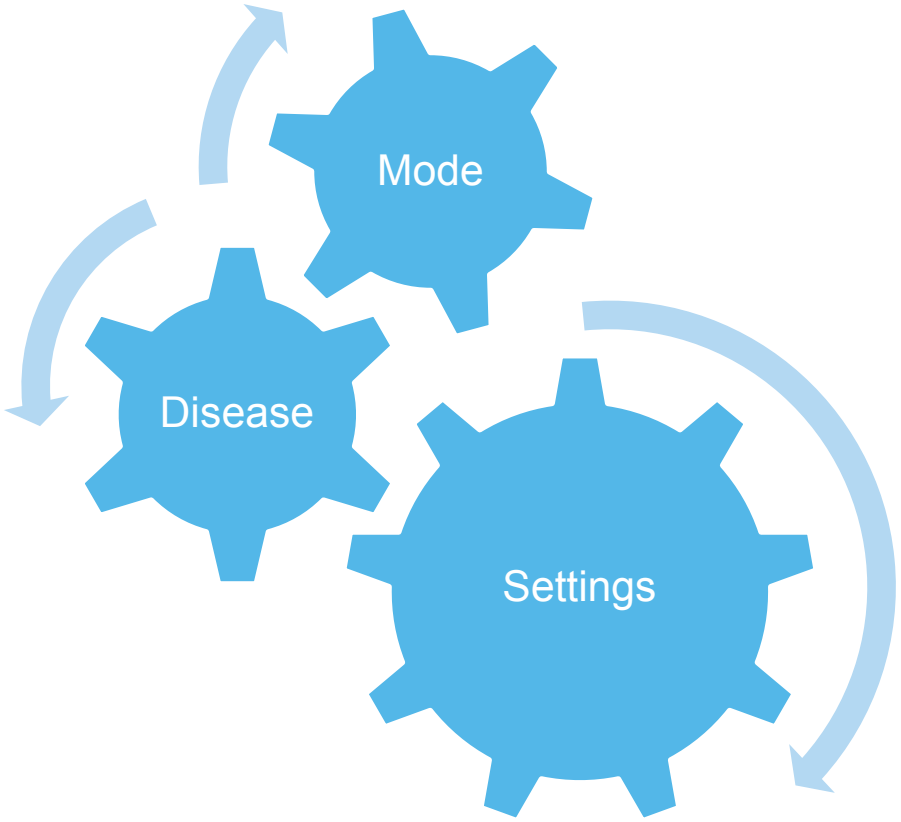
positive results for life™



“What Were You Syncing”

Gary Milne BSRT

Objectives

- List the five common types of asynchrony
- Identify ventilator strategies to improve synchrony
- Differentiate ventilation approaches as it relates to the work of breathing
- Review the management and monitoring of PAV™*+ breath type

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History of Asynchrony

History of Asynchrony

My vent is broken, the patient cant trigger?

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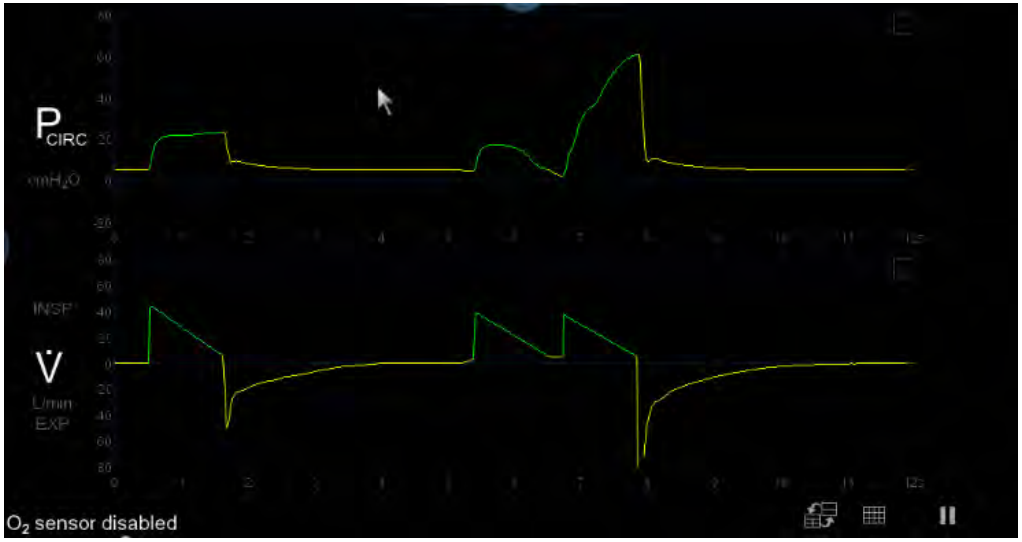
History of Asynchrony – Graphics The Windows To The Lungs



Oh I know what that is, double-trigger asynchrony, want me to txt it to you?

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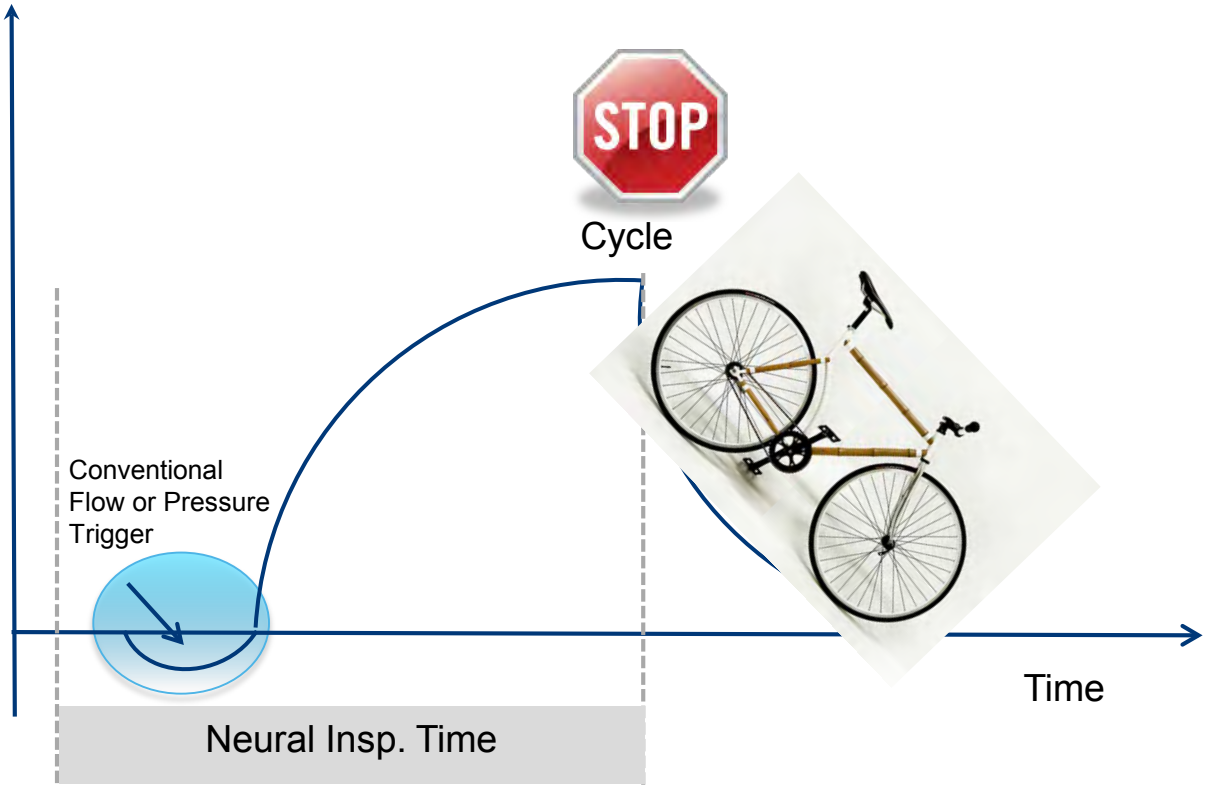
Normal Trigger and Cycle Interaction



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Asynchrony: Incidence and Impact

In observed ventilated patients, 24%-27% exhibited asynchrony in greater than 10% of breaths.[1,2]

Ineffective triggering accounts for 85% of asynchronies.[1]

Patients with an ITI ≥ 10% showed four days more in ventilation time and longer ICU and hospital stays.[2]

ICU staff physicians were able to detect less than one-third of asynchronies, which was higher than the 16% by residents.[3]

1. Thille AW, Rodriguez P, Cabello B, Lellouche F, Brochard L. Patient-ventilator asynchrony during assisted mechanical ventilation. *Intensive Care Med.* 2006;32(10):1515-22.
2. de Wit M, Miller KB, Green DA, Ostman HE, Gennings C, Epstein SK. Ineffective triggering predicts increased duration of mechanical ventilation. *Crit Care Med.* 2009;37(10):2740-5.
3. Colombo D. Efficacy of ventilator waveforms observation in detecting patient–ventilator asynchrony. *Crit Care Med.* 2011;39(11):2452-7.

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Patient-Ventilator Asynchrony

- 24% of mechanically ventilated patients exhibit patient-ventilator asynchrony in >10% of their respiratory efforts during AVC and PS ventilation (ineffective triggering and double triggering)
- Patient-ventilator asynchrony during assisted mechanical ventilation[1]

1. Thille AW, Rodriguez P, Cabello B, Lellouche F, Brochard L. Patient-ventilator asynchrony during assisted mechanical ventilation. *Intensive Care Med.* 2006;32(10):1515-22.

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Common Words or Phrases Assessing the Symptoms of Asynchrony

AGITATED

RESTLESS

FIGHTING THE VENT

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A Vicious Cycle That Could Affect Outcomes

1. Patient is mechanically ventilated

2. Sedation is lightened

One study showed that 42% of all increases in sedation were in response to asynchrony during low tidal volume ventilation.[2,3]

3. Patient becomes agitated

4. Patient is sedated to alleviate agitation.

5. Patient is at increased risk for muscle atrophy

Respiratory muscle atrophy begins in as little as 18 hours.[1]

Although there are multiple reasons atrophy of the diaphragm occurs, it appears that a significant factor is reduced diaphragmatic activity.

1. Levine S, Nguyen T, Taylor N, et al. Rapid disuse atrophy of diaphragm fibers in mechanically ventilated humans. *N Engl J Med.* 2008;358(13):1327-1335.
2. Epstein SK. Optimizing patient-ventilator synchrony. *Semin Respir Crit Care Med*. 2001;22(2):137-152.
3. Pohlman et al Excessive tidal volume from breath stacking during lung-protective ventilation for acute lung injury. *Crit Care Med*. 2008;36(11).

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Patient-Ventilator Asynchrony is one of the Most Cited Reasons for Sedation During Mechanical Ventilation

- A study by Pohlman et al showed that 42% of all increases in the amount of sedation were in response to patient-ventilator asynchrony.[1]
- The ARDS Network protocol for delivering low Vt directs the clinician to adjust the ventilator or give sedation when there are more than three stacked breaths per minute.

1. Pohlman MC. Excessive tidal volume from breath stacking during lung-protective ventilation for acute lung injury. Crit Care Med 2008;36(11);3019-3021.

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Impact of ventilator adjustment and sedation-analgesia practices on severe asynchrony in patients ventilated in assist-control mode[1]

Methods

- MV patients (n=30) who exhibited severe breath-stacking (double-triggering) asynchrony, defined as Asynchrony Index (AI) ≥ 10%, were identified
  - Patients were all ventilated in Assist Control Ventilation (ACV) at time of enrollment
- Clinicians were observed as they managed the care of an asynchronous patient. Clinician-driven interventions in response to asynchrony were classified into three categories:
  - No intervention
  - Adjustment of ventilator settings
- Increase in sedation/analgesia

1. Chanques G, Kress JP, Pohlman A, et al. Impact of ventilator adjustment and sedation-analgesia practices on severe asynchrony in patients ventilated in assist-control mode. *Crit Care Med*. 2013;41(9):2177-2187.

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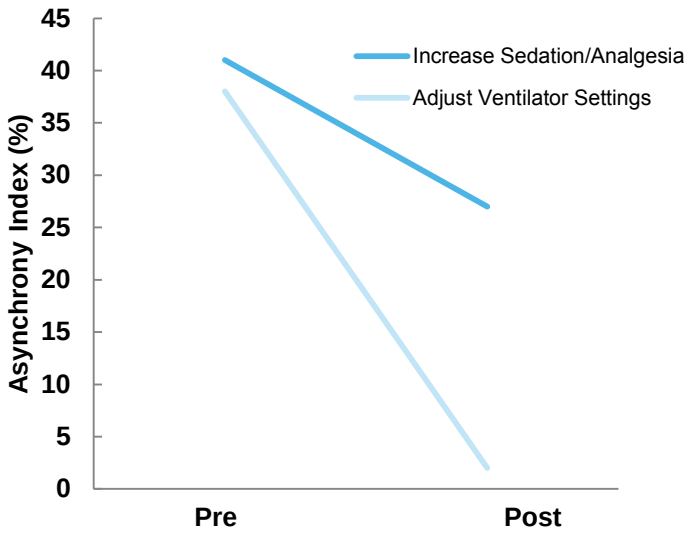
Impact of ventilator adjustment and sedation-analgesia practices on severe asynchrony in patients ventilated in assist-control mode[1]



Authors' Conclusions

Bedside adjustment of ventilator settings is much more effective. Settings changes: Switching from ACV to PSV or increasing inspiratory time in ACV.

1. Chanques G, Kress JP, Pohlman A, et al. Impact of ventilator adjustment and sedation-analgesia practices on severe asynchrony in patients ventilated in assist-control mode. *Crit Care Med*. 2013;41(9):2177-2187.

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Monitoring of Patient-Ventilator Interaction at the Bedside – Quotes About Settings

> "The patient is the focus point, and the clinician must adjust the mechanical ventilator to meet the patient's ventilatory requirements. The goal is to have the 'right tool for the right job,' and clinicians must not assume that one 'tool' (i.e., set of ventilator parameters) satisfies the needs of different patients."[1]

> "…Sedation and neuromuscular blocking agents should not be used routinely to improve patient-ventilator synchrony. These agents should be used only after clinicians have optimized synchrony, and depression of the patient's respiratory effort is still required."[1]

1. de Wit M. Monitoring of patient-ventilator interaction at the bedside. *Respir Care*. 2011;56(1):61-72.

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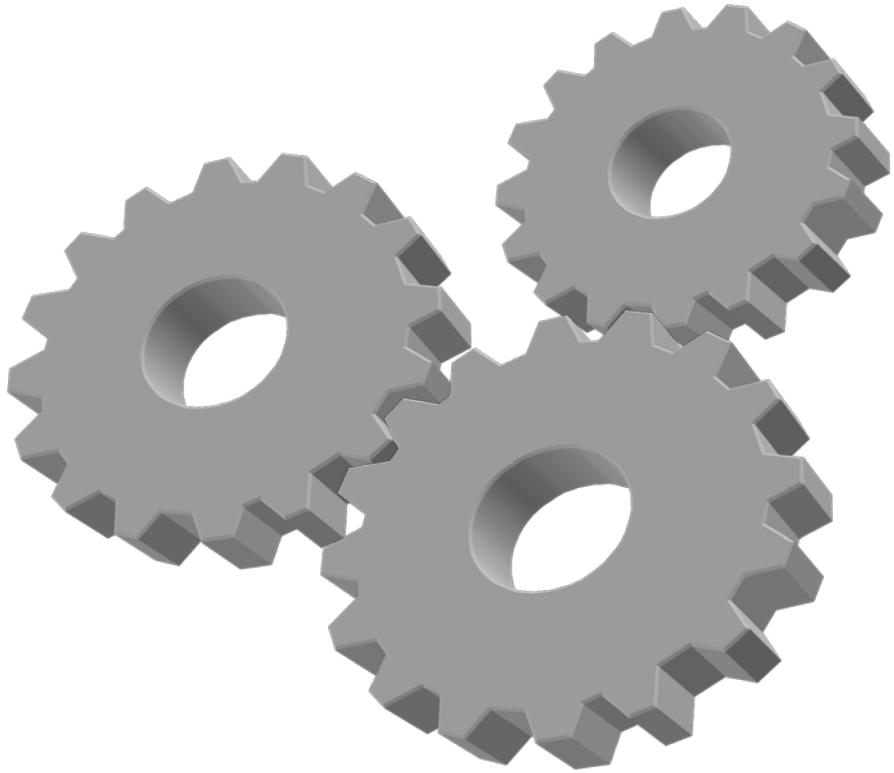
Patient Factors Contributing to Asynchrony

Resistance	↑
Compliance	↑ ↓
COPD – intrinsic PEEP	↑
Minute ventilation	↑



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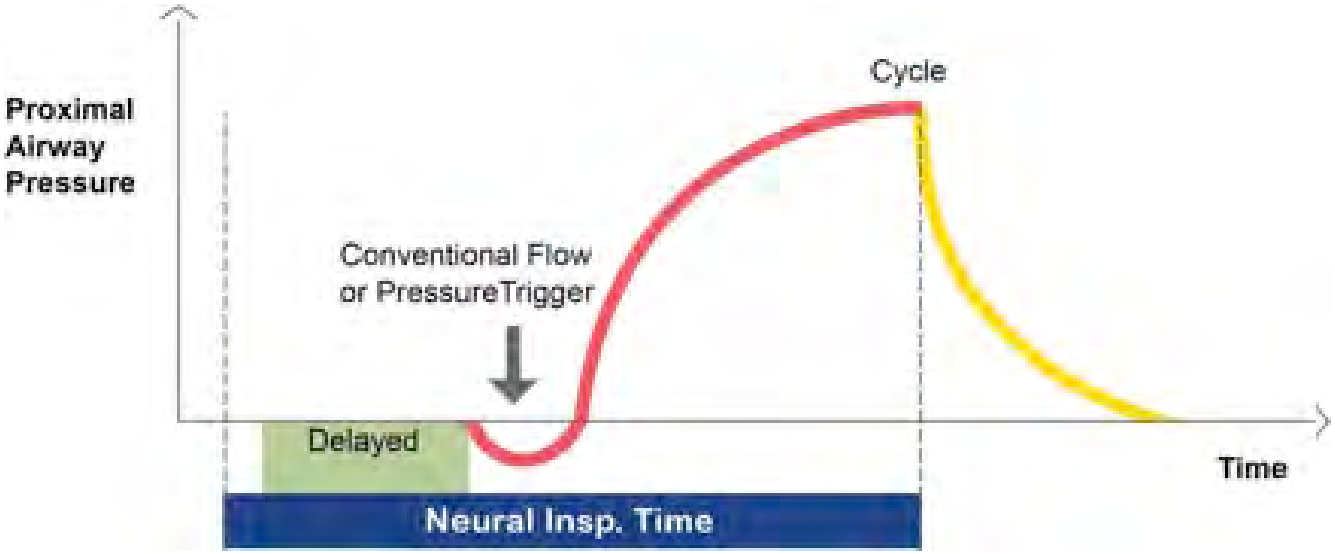
Types of Patient-Ventilator Asynchrony

- Delayed triggering
- Auto triggering
- Ineffective efforts
- Double triggering
- Delayed and early cycling
- Flow asynchrony



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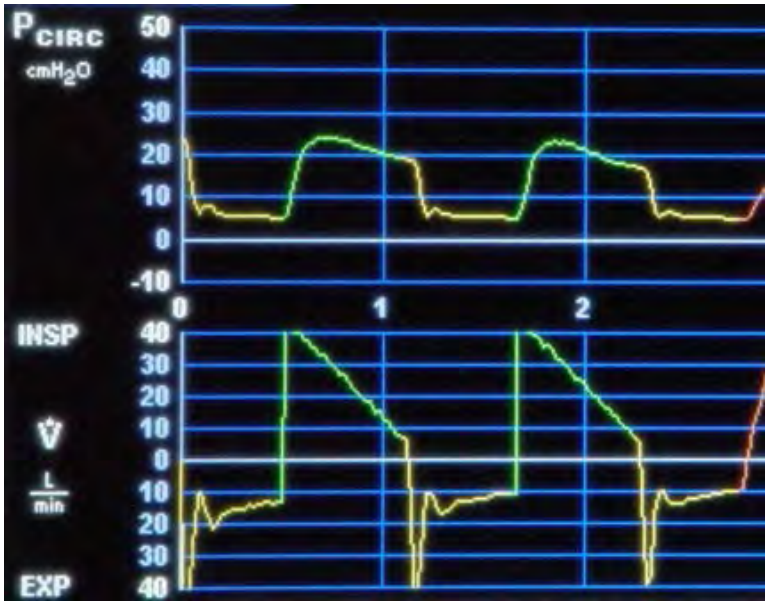
Causes of Delayed Triggering

- Intrinsic PEEP
  (common with COPD patients)
- Ineffective respiratory drive
  (including caused by sedation)
- Muscle weakness
- Insensitive trigger



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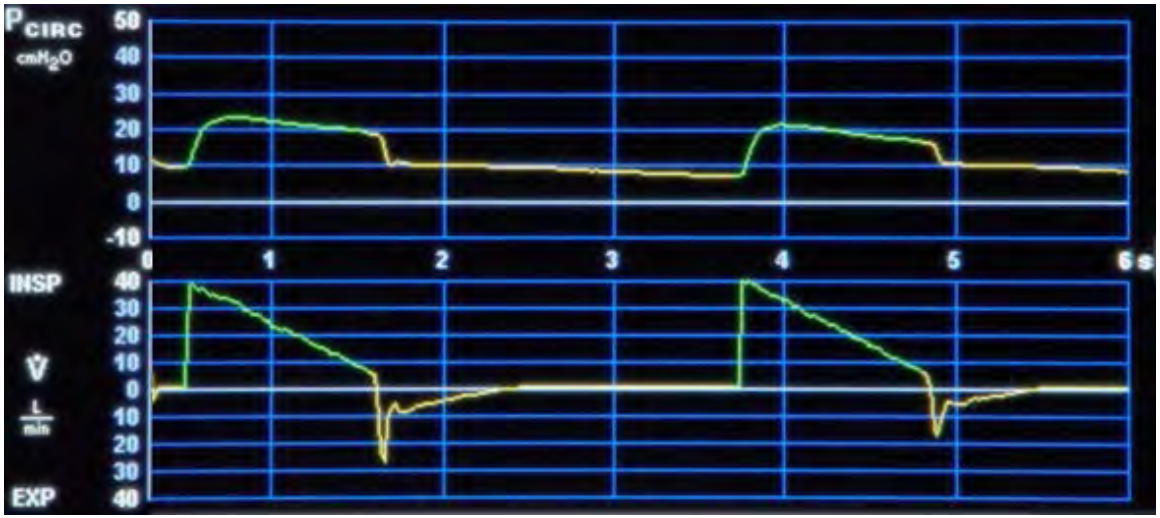
Auto-trigger

- When the setting is too low for conditions
- Leaks
- Water in circuit
- Hyper-dynamic cardiac state



Epstein SK. How often does patient-ventilator asynchrony occur and what are the consequences?. *Respir Care.* 2011;56(1):25-38.

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CAUTION
THIS SIGN HAS
SHARP EDGES
DO NOT TOUCH THE EDGES OF THIS SIGN
ALSO, THE BRIDGE IS OUT AHEAD

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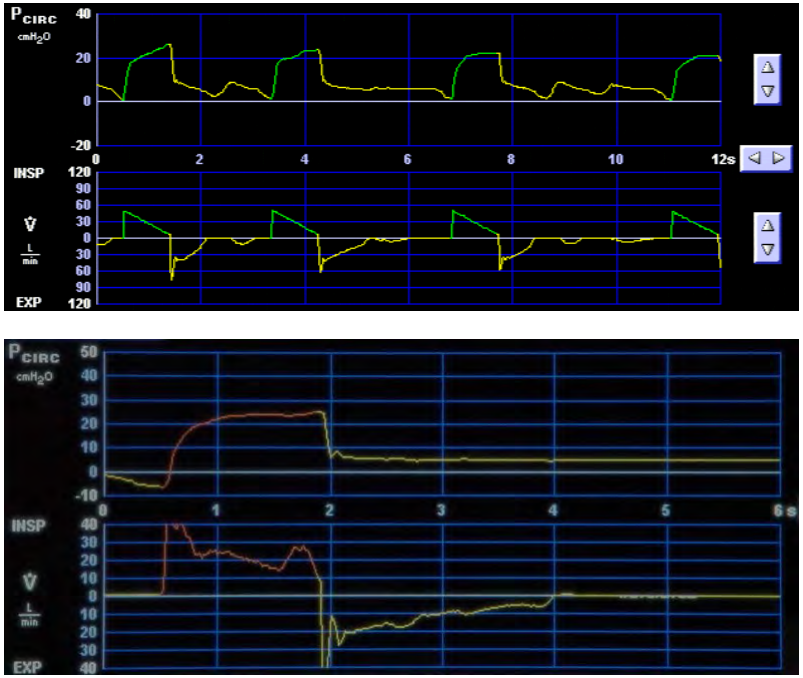
Ineffective Efforts or Triggering

- Most common form of asynchrony[1]
- Can be detected by exam of the pressure and flow curves
- Most commonly occur during exhalation but can occur during inspiration



1. De wit M. Monitoring of patient-ventilator interaction at the bedside. *Respir Care.* 2011;56(1):61-72.

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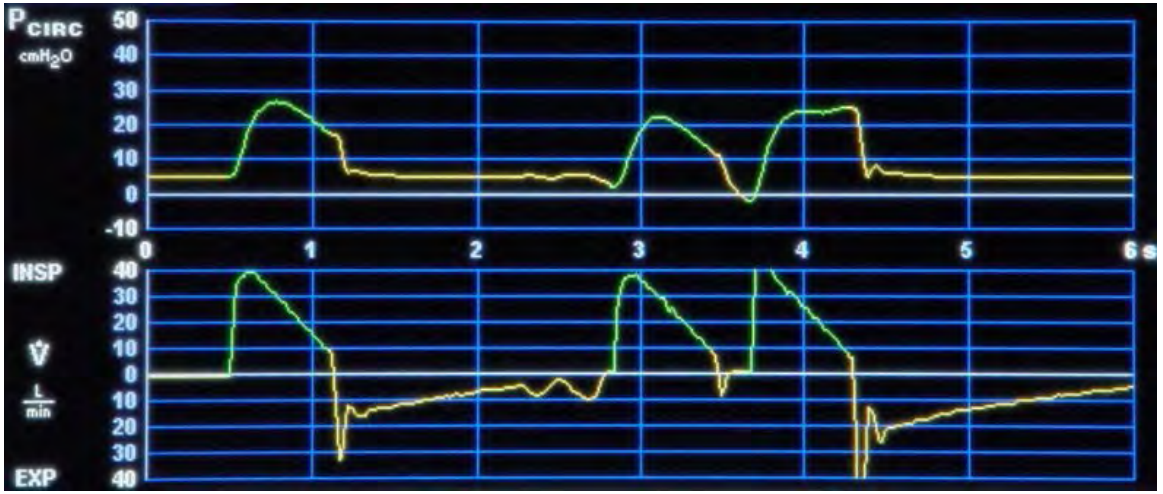
Double Trigger



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Double Triggering[1]

- Two consecutive inspirations with very little or no exhalation
- Caused by:
  - High respiratory drive
  - Too low of a set tidal volume
  - Neural inspiratory time is longer than set by operator

1. De wit M. Monitoring of patient-ventilator interaction at the bedside. *Respir Care.* 2011;56(1):61-72.

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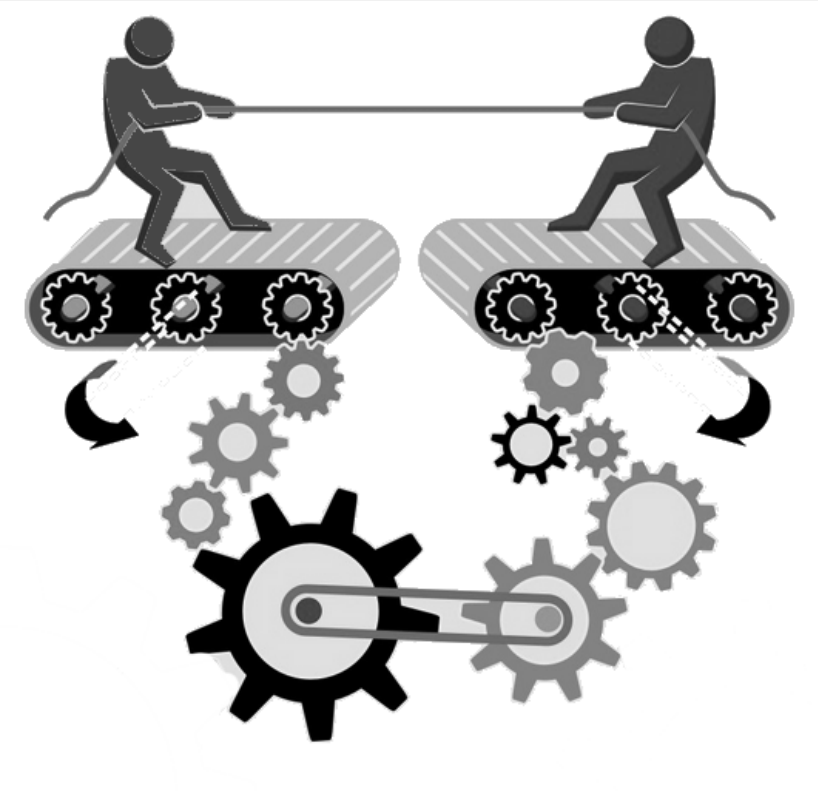
Basic Ventilator Parameters and Conflict

- Rate
- Tidal volume (V_T)
- Inspiratory pressure
- E_{sens}
- Peak flow
- Inspiratory time (I:E ratio)
- Flow pattern



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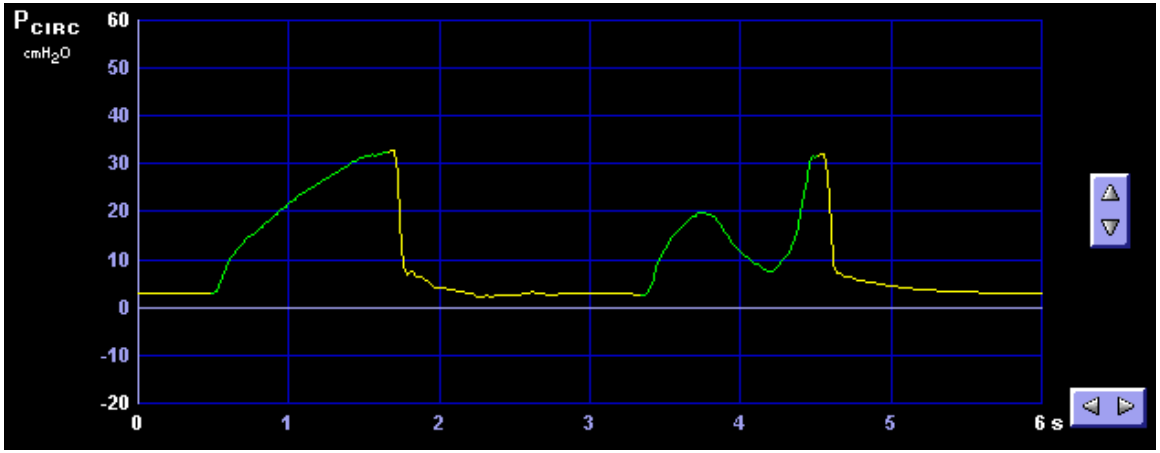
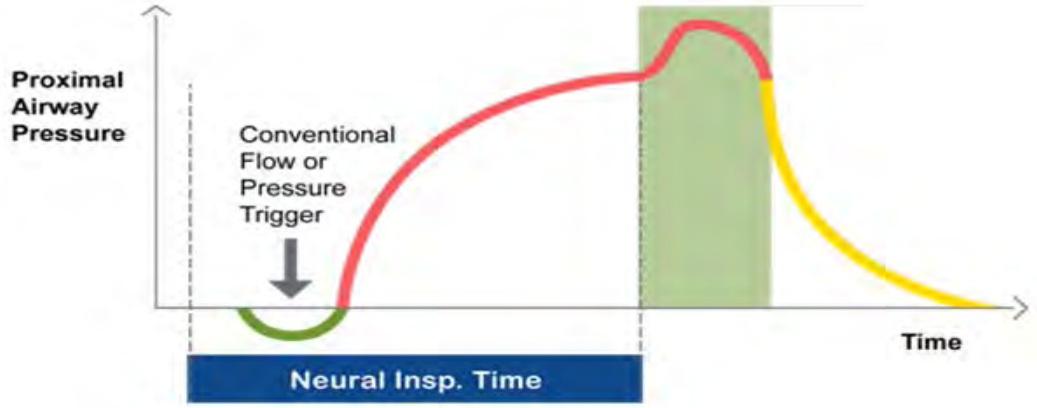
Flow Asynchrony

- Occurs when flow is fixed
- Solution is to increase flow or switch to another mode

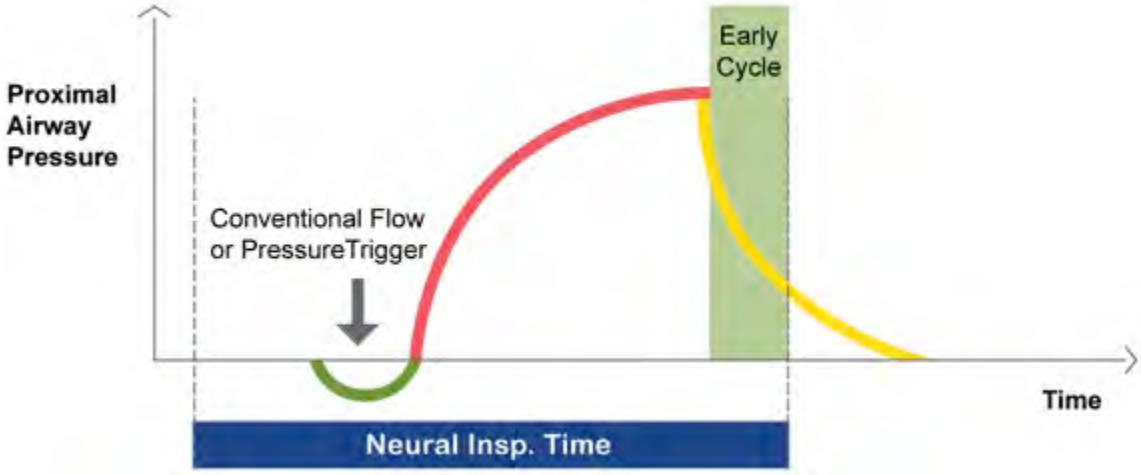


Asynchrony Can Occur in Cycling Where's the Sense in That?

Delayed cycle



Early cycle



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How Do Breaths Cycle Off?

- Volume Control – volume or time
- Pressure Control – time
- Dual modes or adaptive modes – time
- Pressure Support – decay of flow, or pressure target or time
- PAV™*+ mode – cessation of inspiratory effort

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The Role of Noninvasive Interfaces and Asynchrony

- Devices will typically have a leak
- What problem does that pose?
  - Delayed cycling off
  - 40% of patients receiving NIV had an asynchrony index >10%[1]

1. Vignaux L, Vargas F, Roeseler J, et al. Patient-ventilator asynchrony during non-invasive ventilation for acute respiratory failure: a multicenter study. *Intensive Care Med*. 2009;35(5):840-846.

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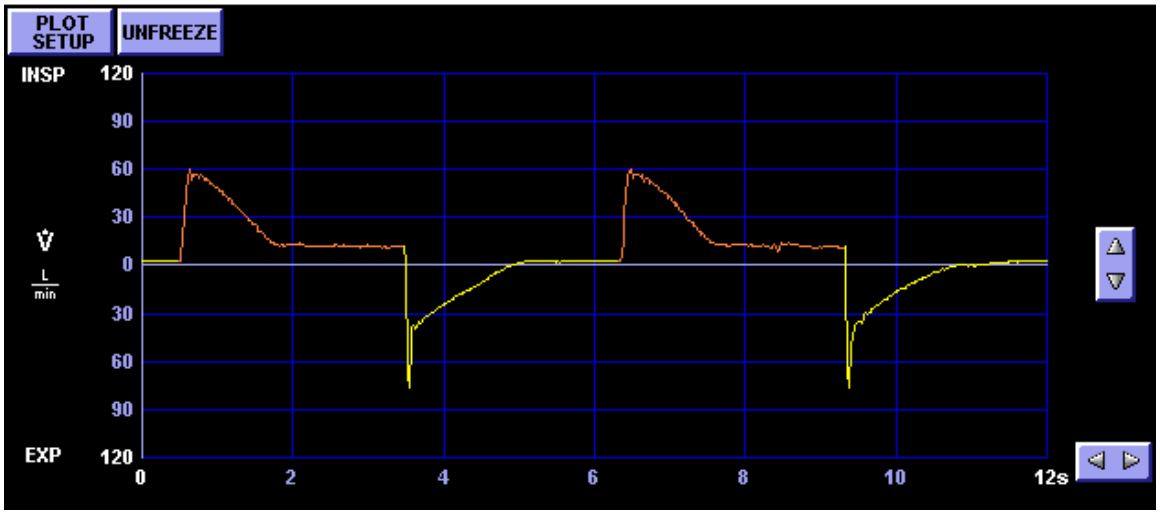
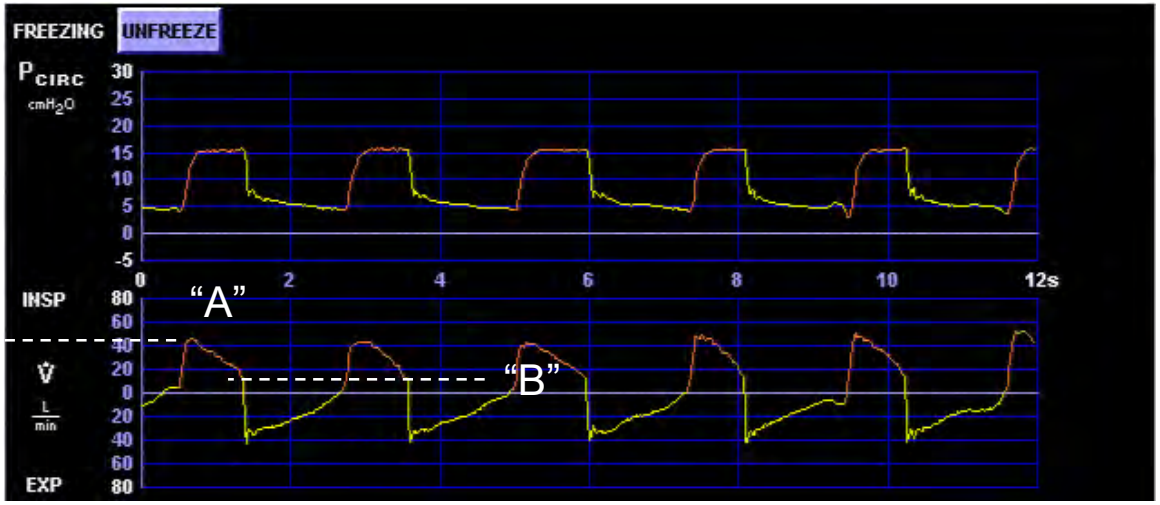
Challenges With Noninvasive Ventilation

- Identification of auto triggering
- Identification of delayed cycling
- Manual adjustments to correct auto triggering and delayed cycling



Pressure Support Cycling Criteria

- When “B” reaches a percentage of “A”, inspiration ends



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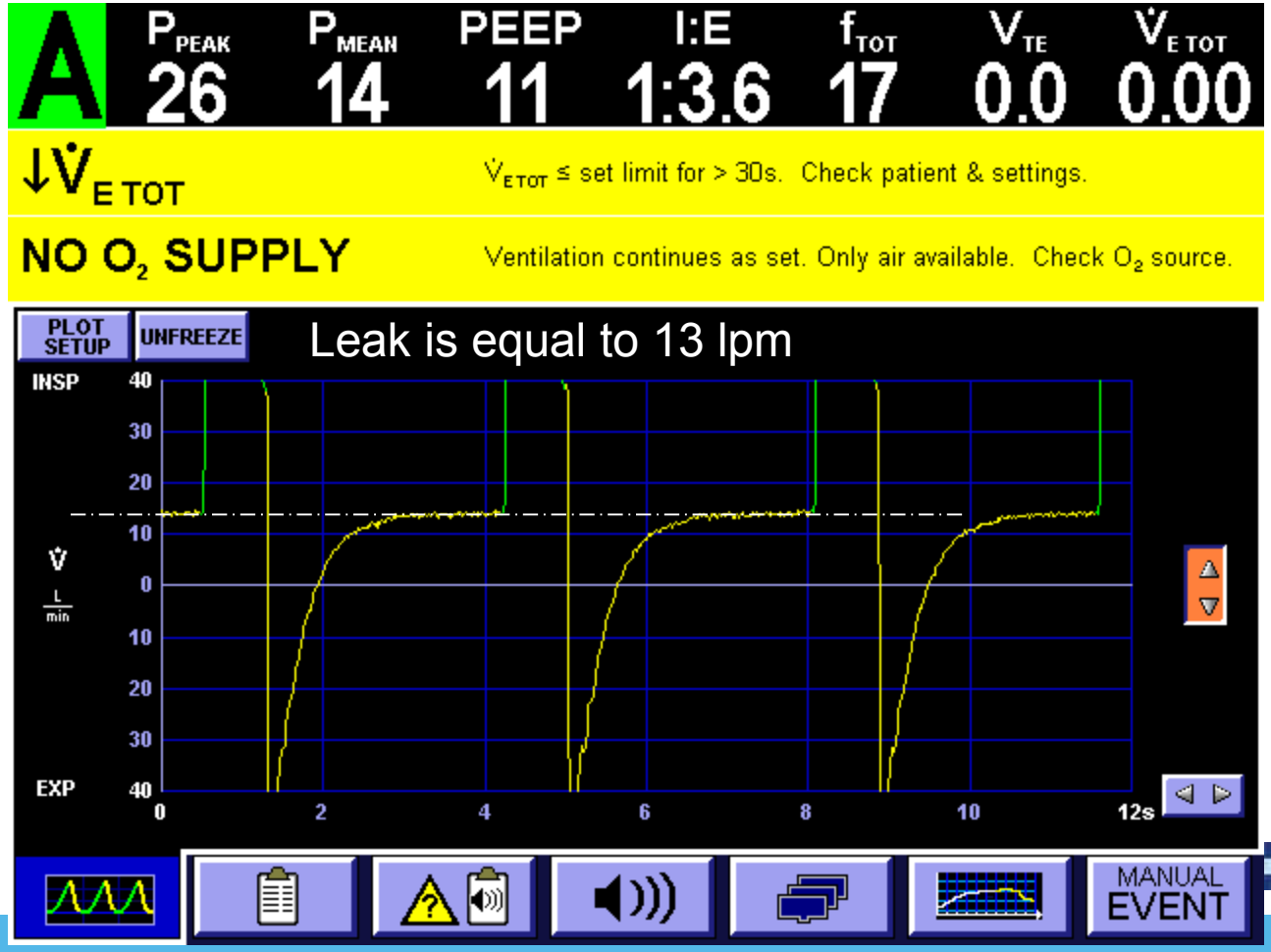
Where To Set The Sensitivity?
3,5,7,9 LPM – It would Result in Autocycling



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Synchrony at Home

Would you like to go out for dinner?
What would you like to eat?

Man

Women

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Conclusions

- There are many types of asynchrony
- They occur frequently
- Asynchrony is associated with an increased duration of mechanical ventilation[1]
- Modes of ventilation have varying responses to increased demand
- Your skill in graphic interpretation will make the difference!

1. Thille AW, Rodriguez P, Cabello B, Lellouche F, Brochard L. Patient-ventilator asynchrony during assisted mechanical ventilation. *Intensive Care Med.* 2006;32(10):1515-22.
2. Xirouchaki N, Kondili E, Vaporidi K, et al. Proportional assist ventilation with load-adjustable gain factors in critically ill patients: comparison with pressure support. *Intensive Care Med*. 2008;34(11):2026-2034

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