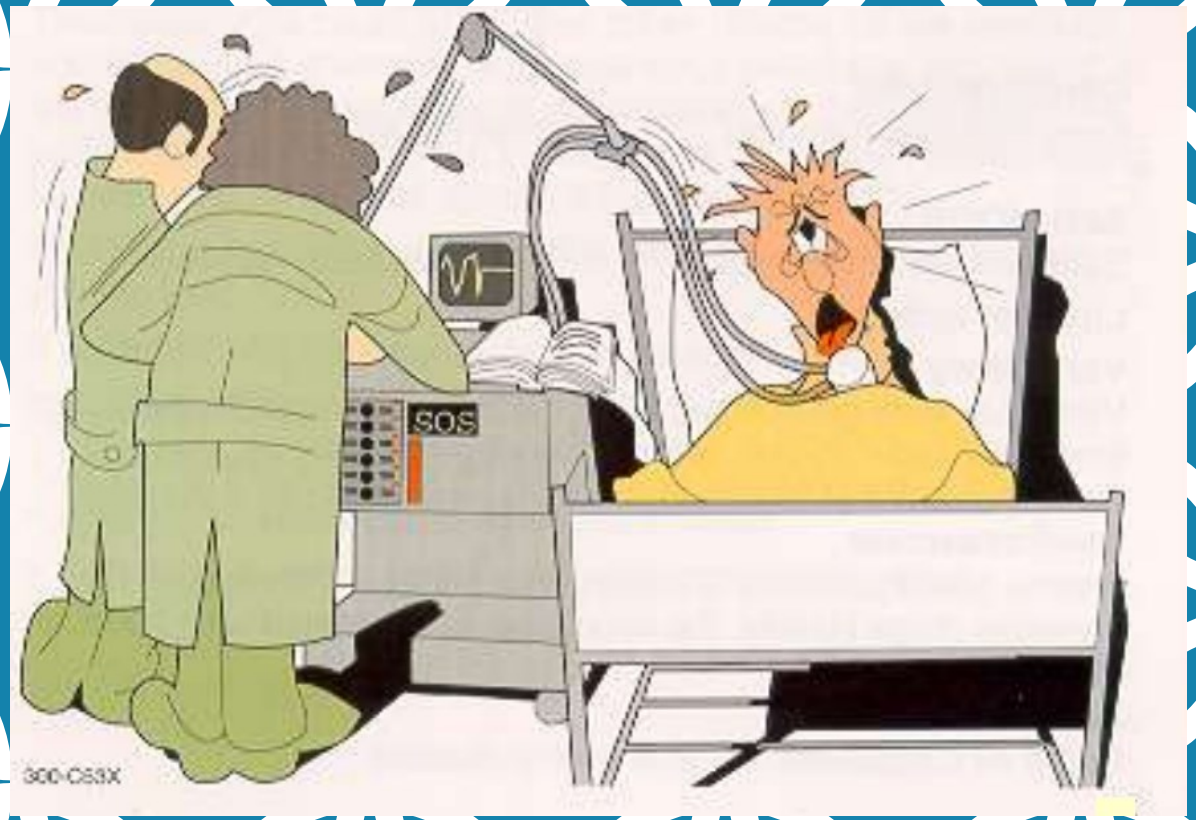


PATIENT VENTILATOR DYSSYNCHRONY

GEORGE SAVIO CHALAM
RESPIRATORY THERAPIST
SUHRC

DISCUSSION

Introduction

Phase variable

Dyssynchrony

INTRODUCTION

Mechanical ventilation is a commonly used intervention in the ICU.

Decrease work of breathing and maintain adequate levels of gas exchange.

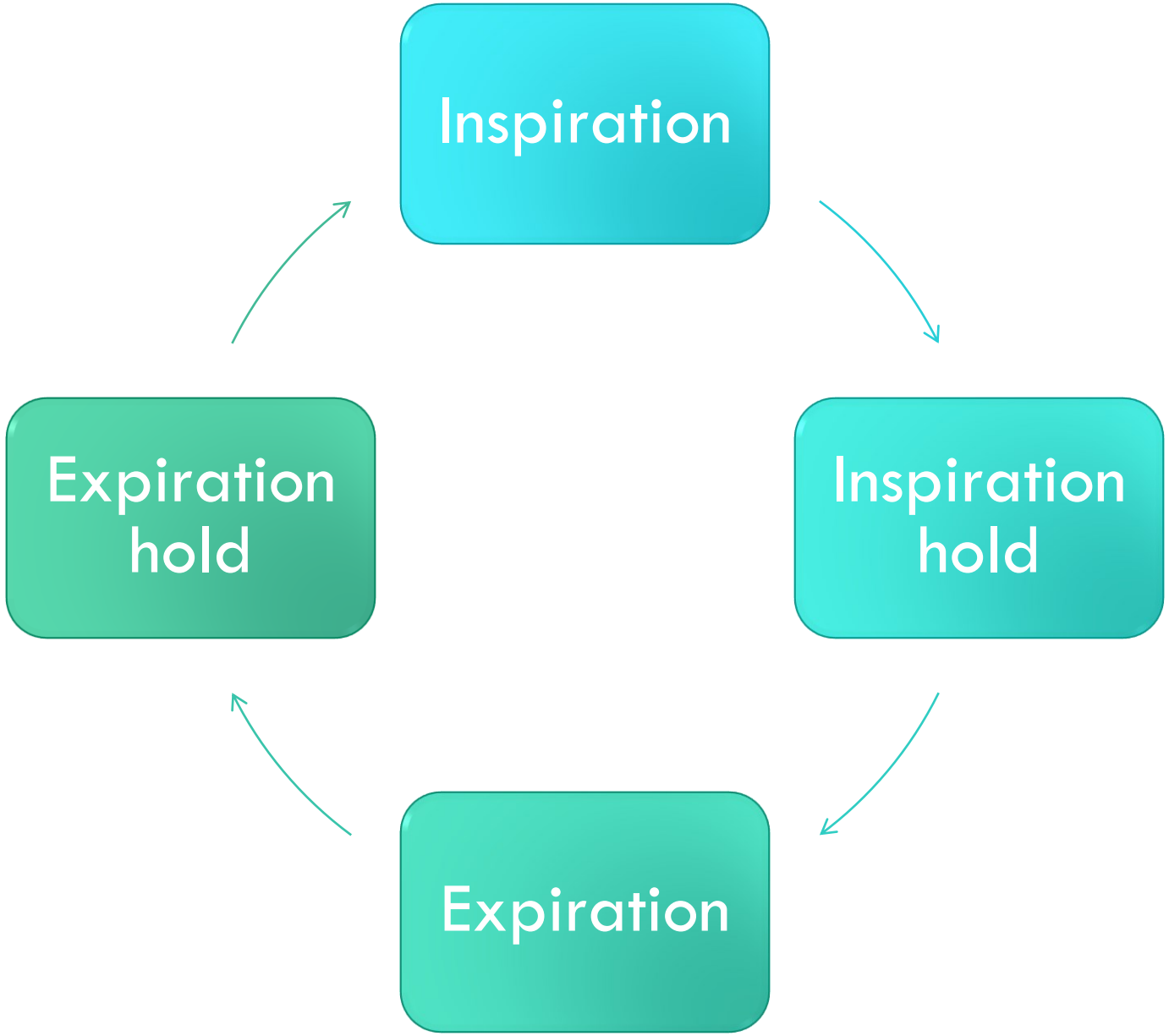
Patient-Ventilator Dyssynchrony (PVD) is often described as a patient “fighting” the ventilator.

Patient-Ventilator Dyssynchrony (PVD) can be defined as a failure of synchronize the provided breath support from a ventilator with the patient’s spontaneous effort.

Occur due to: inappropriate time and delivered parameter.

PVD leads to:

i. Patient discomfort
ii. Lung injury
iii. Over sedation
iv. Increase ventilator days.


Inspiration
Inspiration hold
Expiration
Expiration hold

WHAT WE CONTROL

Control variable

Pressure

Volume

Flow (indirect)

Time

Phase variable

Trigger

- Flow
- Pressure
- Time

Limit

- Pressure
- Volume
- Flow
- Time

Cycling

- Time
- Flow
- Pressure
- Volume

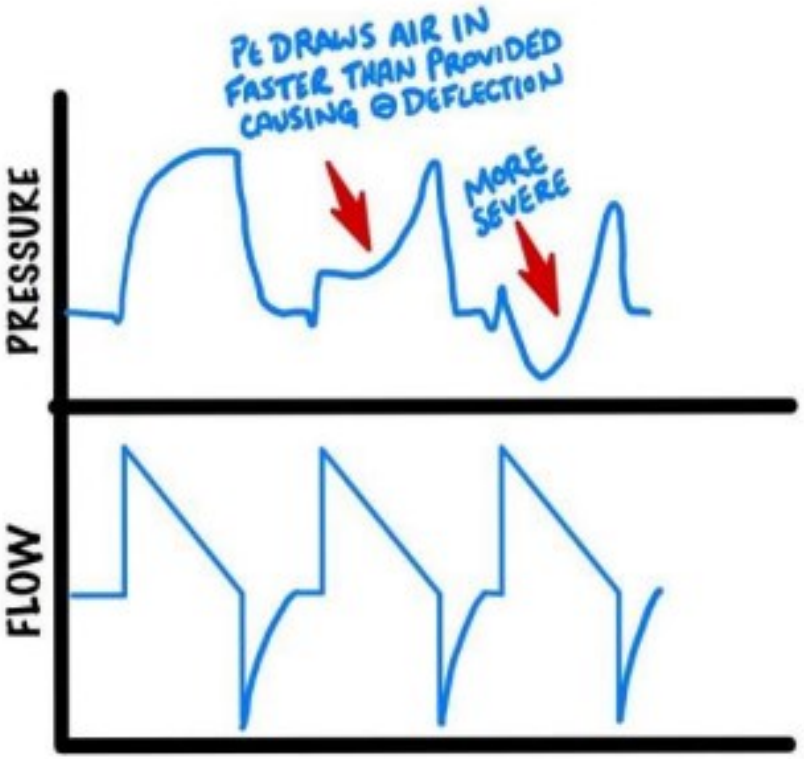
DYSSYNCHRONY

Estimated occurrence of PVD is reported to range from 10% to 85%.

Dyssynchrony occurs through inappropriate trigger sensitivity, limit, and cycling.

Flow dyssync	Trigger dyssync	Cycle dyssync
• Inadequate • Overshoot	• Auto triggerring • Failed triggering	• Early cycling • Delayed cycling

FLOW DYSSYNCHRONY



Inadequate flow

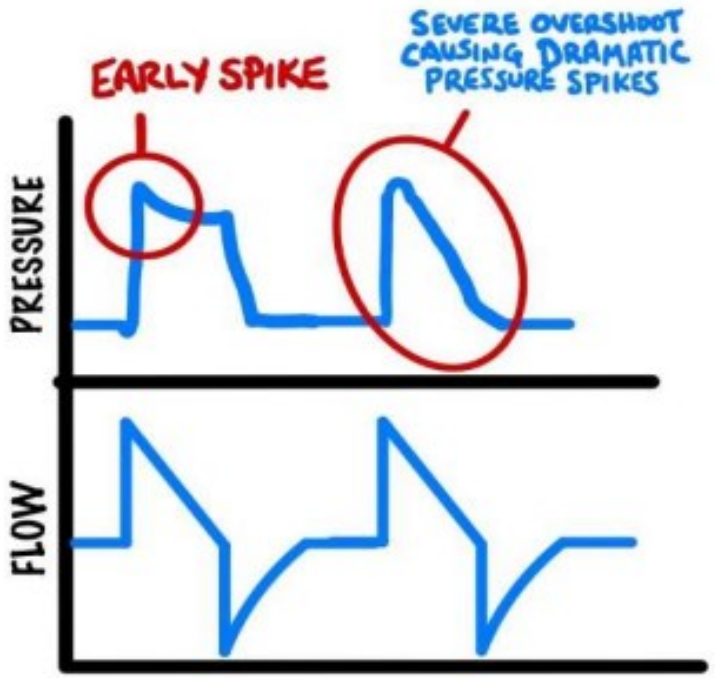
when the patients flow demand is more than the ventilator is set up to provide. (flow hunger).

increased respiratory fatigue and oxygen consumption.

increase in transpulmonary pressure, developing lung injury

Cause of inadequate flow	Corrective measures
I. Inadequate flow settings on ventilator II. Fixed flow targeted breaths III. Acute respiratory failure IV. Increased respiratory drive V. Fever Pain	VCV – I. Increase inspiratory flow – II. Switch to pressure modes as flow varies with patient effort. III. Pressure Modes - Shorten rise time IV. Address underlying cause - Pain, fever, etc.

FLOW DYSSYNCHRONY



Overshoot flow

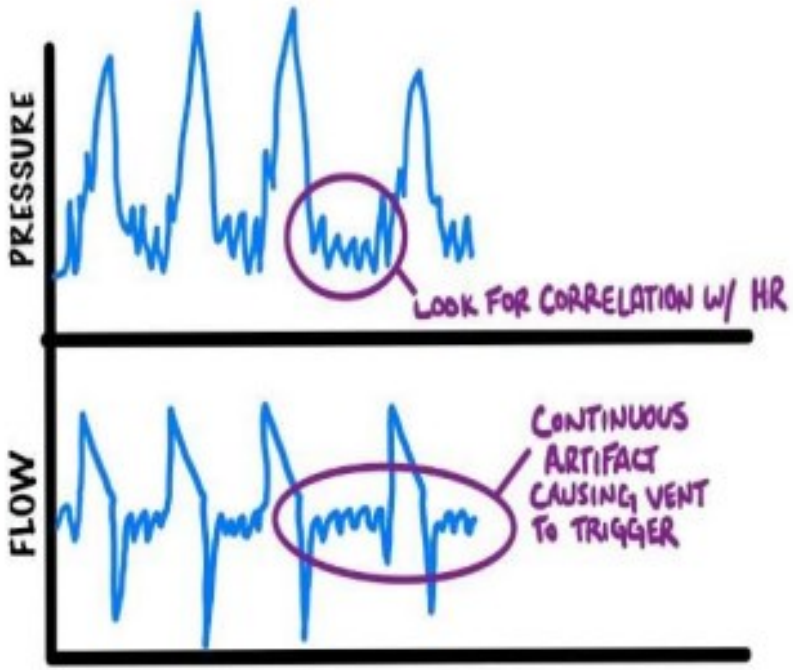
ventilator is set to deliver a breath faster than the patient desires.

Recognition: An early spike in the pressure scalar is observed during the inspiratory phase.

patient discomfort, artificially shortens the breath.

Causes of Flow Overshoot	Corrective Measures
Ventilator flow exceeds what patient wants – I. Volume Modes: Flow set too high. II. Pressure Modes: ITime too fast or Inspiratory pressure too high.	I. VCV - Decrease flow II. Pressure Modes - Lengthen rise time

TRIGGER DYSSYNCHRONY



Auto trigger:

which occurs when **unwanted breaths are repeatedly delivered** due to a false activation of the ventilator

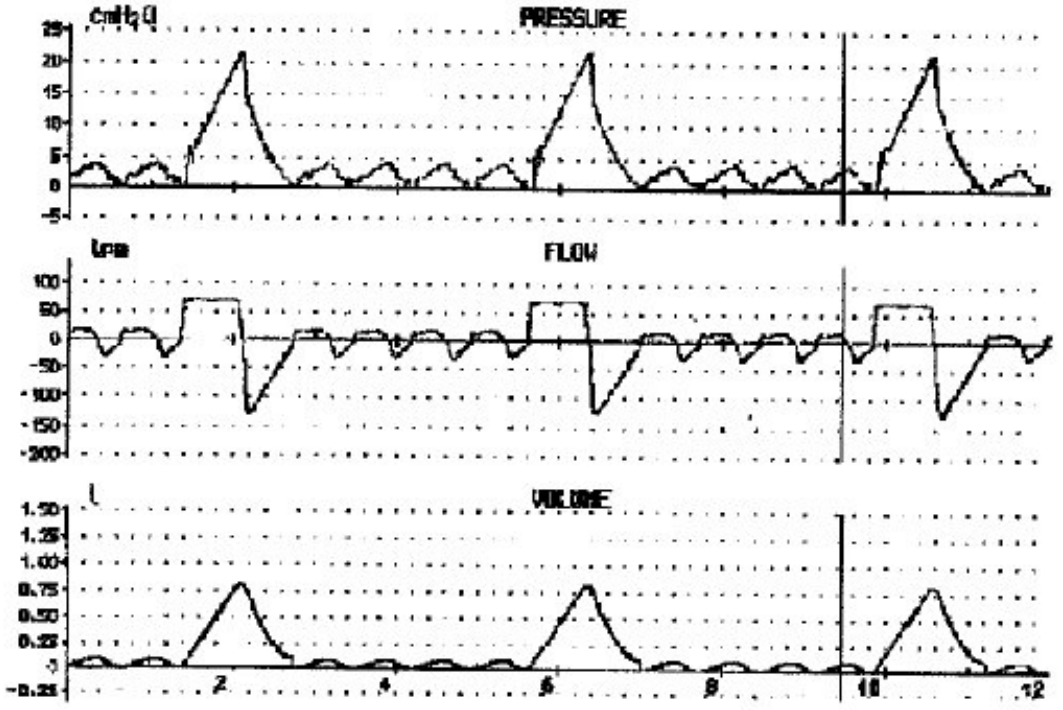
commonly observed in **flow sensed triggers** as they can be more sensitive.

Recognition: Continuous baseline artifact seen in the setting of rapid respiratory rate

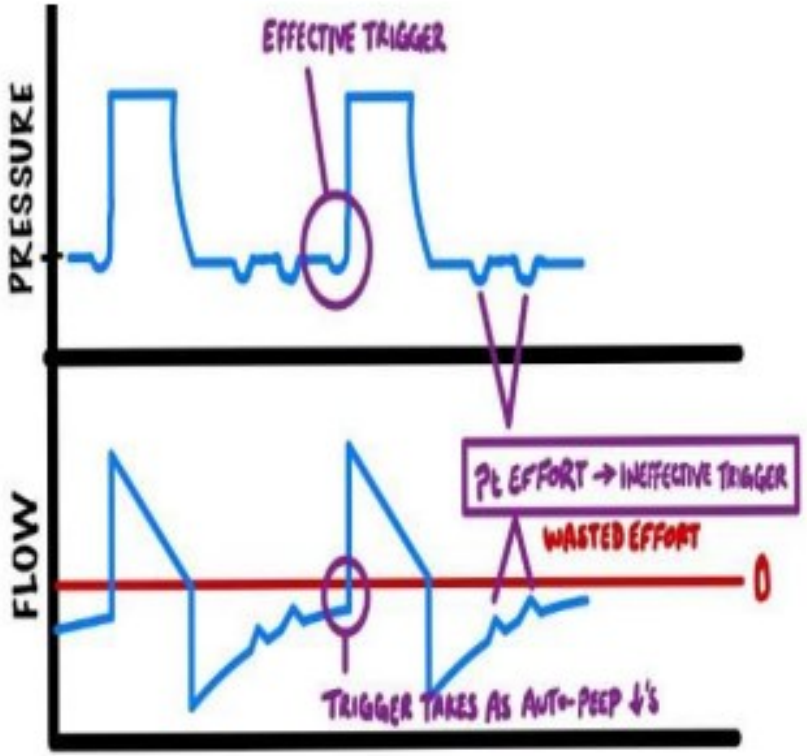
respiratory alkalosis, failed spontaneous breathing trials leading to increased sedation, and prolonged course of mechanical ventilation.

Causes of Autotriggering	Corrective Measures
I. Cardiac oscillations II. Air leak/ Fluid in circuit III. Breath trigger too sensitive	I. Eliminate source: remove leaks and excess fluid II. Switch from flow to pressure sensor III. Decrease sensitivity of trigger

Auto-triggering from leak



TRIGGER DYSSYNCHRONY



Failed trigger:

usually occurs because of the patient's insufficient respiratory effort to trigger the ventilator, resulting in a wasted effort from ventilator.

Also occur in response to elevated intrinsic PEEP (Auto PEEP).

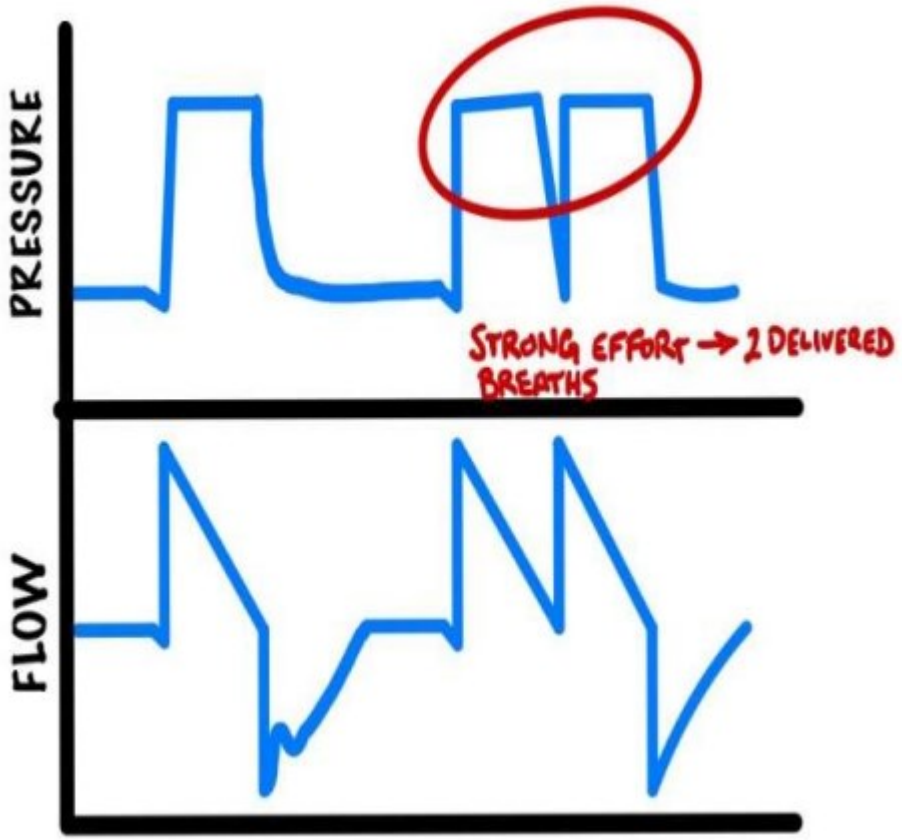
Recognition: Intrinsic PEEP manifests itself in the expiratory flow not returning to zero before the next breath is delivered.

respiratory muscle fatigue, dynamic hyperinflation, reduced venous return, and cardiovascular collapse.

Causes of Trigger Failure	Corrective Measures
I. Intrinsic PEEP (AutoPEEP): Most common cause of trigger failure: - II. Obstructive lung diseases – III. Large tidal volumes - Rapid respiratory rates IV. Inappropriate Trigger settings: - Flow Trigger - Pressure Trigger V. Respiratory muscle weakness VI. Decreased neural drive	I. Decreasing Intrinsic PEEP - Reduce respiratory rate - Decrease inspiratory time – II. Reduce work of triggering ventilator - Increase extrinsic PEEP III. Increase trigger sensitivity IV. Consider removal or reduction of sedation, neuromuscular blockade, and neural drive depressants.

Trigger failure

CYCLE DYSSYNCHRONY



Pre- mature cycling:

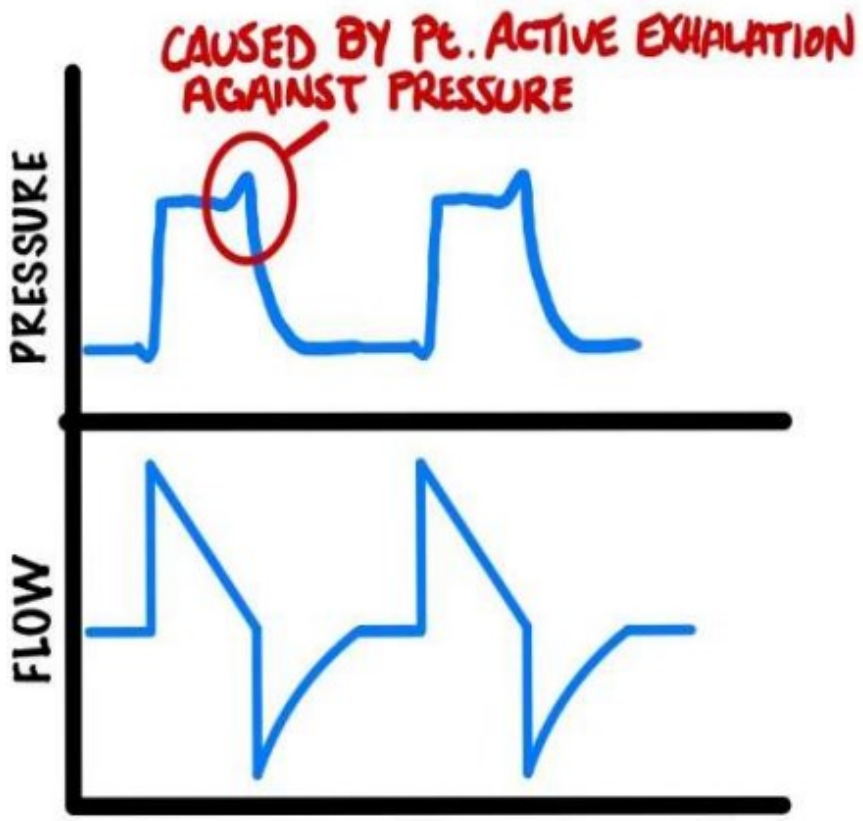
Also known as breath stacking or double triggering,

occurs due to an **imbalance between the ventilator I-time**, tidal volume, or **flow being less** than that of the patient.

Tachypneic, strong contraction of the diaphragm, **patient I-time is longer than the machine's I-time** the ventilator deliver an untimely second breath.

Causes of Premature Cycling	Corrective Measures
I. The ventilator I-Time is shorter than the patients intrinsic I-Time. II. Prolonged patient effort is sensed by the ventilator as a new breath III. Low tidal volume in VCV	I. VCV - Increase tidal volume - Decrease flow II. Pressure Modes - Increase set I-Time

CYCLE DYSSYNCHRONY



Delayed cycling

opposite of premature cycling

the machine's Itime is longer than the patients natural I-time.

The flow scalar is typically unchanged. end inspiratory pressure spikes are observed denoting patient effort to exhale prematurely.

Auto PEEP can develop due to longer than needed I-times.

Causes of Delayed Cycling	Corrective Measures
I. The ventilator I-Time is more than the patients intrinsic I-Time. II. Large tidal volumes in VCV III. Long set I-time in PCV	I. VCV - Decrease tidal volume - Increase flow II. Pressure Modes - Decrease set I-Time

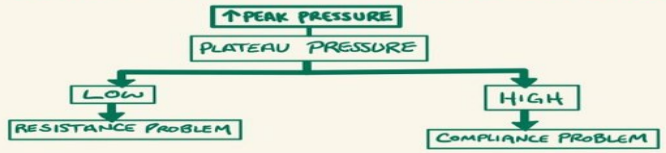
7 Forms of Ventilator Dyssynchrony

Alarm Dyssynchrony
- Problems with alarm settings on machine

Peak Pressure Apnea
- Early termination of inspiratory flow before full V_T achieved

What causes it?	How do I fix it?
- Seen in VC as ↑ peak pressure causes termination of breath delivery	- ↑ Peak pressure alarm settings - Determine plateau pressure • Compliance vs Resistance - Fix underlying issue

* Peak peassure going off around 40 cmH2O causing low tidal volumes



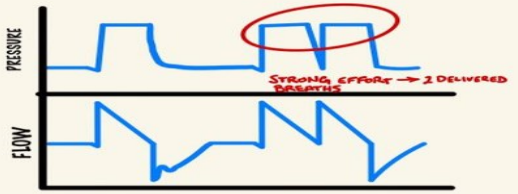
Cycle Dyssynchrony - Problems ending the breath

Early Cycling "Breath Stacking"
Breath ends as Pt still taking breath

What causes it?	How do I fix it?
I-time (set on machine) is less than Pt intrinsic I-time • Prolonged Pt effort = machine sensing new effort as breath ends	• VC: ↑ V_T, can ↓ flow (but may cause flow starvation • PC: ↑ set I-time

x Double stacking causes V_T and inspiratory pres. that far exceeds set parameters
- ↑ Lung injury

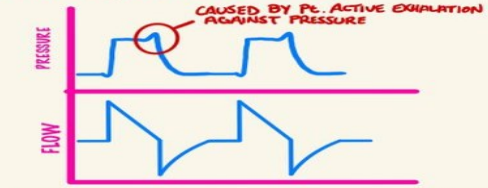
Reverse triggering: vent delivered breath triggers a Pt. initiated breath
- Unclear etiology may be due to reflex diaphragm stimulation
- MC if deeply sedated / comatose
  - This can confuse neuro exam
- Absence of initial breath being Pt. triggered helps to distinguish early vs reverse
- Fix with
  - Switch to PSV
  - ↓ Sedation
  - ↓ Resp rate
  - Paralytic (if refractory/harmful)



Delayed Cycling
- I-time (set on machine) is More than Pt. "intrinsic I-time" → machine breath continues longer than Pt. breath

What causes it?	How do I fix it?
Vent I-time > Patient natural I-time - Excessive V_T, long I-time	- VC: ↑ flow or ↓ V_T (will ↓ I-time) - PC: ↓ I-time

* May ↑ Pt. discomfort
* Longer I-time can promote autoPEEP (bc ↓ time for exhalation)



Trigger Dyssynchrony
- Problems initiating breath

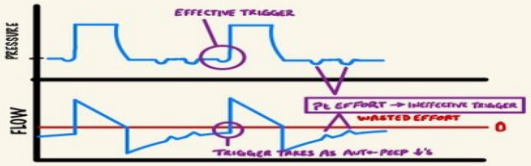
Autotriggering
- Unwanted breath delivered repeatedly due to false trigger

What causes it?	How do I fix it?
- Sensor is too sensitive - Cardiac oscillations - Air leaks - Fluid in circuit	#Eliminate source: Remove leaks / excess fluid - ↓ sensitivity of trigger - Switch from flow to pressure trigger

* ↑ Rate may cause significant discomfort for Pt., lead to SBT failure if not recognized, or cause respiratory alkalosis

Failure to Trigger
- Pt. can't trigger vent or breath is delayed after Pt effort

What causes it?	How do I fix it?
- AutoPEEP (mc): COPD, ↑ V_T, ↑ Resp Rate, etc. - Trigger settings • Flow • Pressure	↓ AutoPEEP: ↓ resp rate, ↓ insp time, reverse cause ↑ trigger sensitivity (careful as may cause opposite problem) ↑ Extrinsic PEEP (½ work of triggering)



* MC form of ventilator dyssynchrony
* ↓ Pt comfort → can lead to more sedation
* ↑'s WOB, ↓ CO, and cardiac collapse

Flow Dyssynchrony
- Problems delivering breath

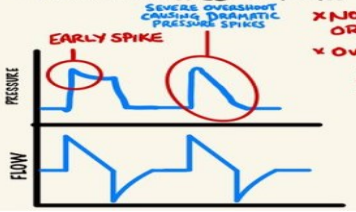
Inadequate Flow
- Not enough flow to support the Pt flow demands

x Problem bc the Pt is breathing hard against vent
- Failed work shifting to ventilator
- ↑ Resp muscle fatigue
- ↑'d O_2 consumption
- ↑ TPP → ↑ risk of barotrauma

What causes it?	How do I fix it?
- The Pt flow is more than what vent will provide	- ↑ Inspiratory flow - Switch to pressure mode - Manage cause (fever, pain, etc.)

x May look like stress index >1 (V_T > compliance) that can cause volutrauma
- Flow problems seen during active breath whereas compliance issue pattern seen in passive breaths

Flow Overshoot
- Flow delivered is more than what Pt. wants



x Not common, may see in VC if flow was initially too high or in PC if I-time fast / insp pressure too high

x Overshoot can
- ↑ Pt. discomfort
- Artificially shorten breath
- ↑ Respiratory rate

What causes it?	How do I fix it?
- Vent flow > what Pt wants	- ↓ Flow in VC - Lengthen rise time in pressure modes