PATIENT VENTILATOR DYSSYNCHRONY

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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.
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**
  - Inadequate
  - Overshoot

- **Trigger dyssync**
  - Auto trigerring
  - Failed triggering

- **Cycle dyssync**
  - 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).

increase in respiratory fatigue and oxygen consumption.

increase in transpulmonary pressure, developing lung injury
<table>
<thead>
<tr>
<th>Cause of inadequate flow</th>
<th>Corrective measures</th>
</tr>
</thead>
</table>
| I. Inadequate flow settings on ventilator | 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. |
| II. Fixed flow targeted breaths |
| III. Acute respiratory failure |
| IV. Increased respiratory drive |
| V. Fever Pain |
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

<table>
<thead>
<tr>
<th>Causes of Flow Overshoot</th>
<th>Corrective Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventilator flow exceeds what patient wants –</td>
<td></td>
</tr>
<tr>
<td>I. Volume Modes: Flow set too high.</td>
<td>I. VCV - Decrease flow</td>
</tr>
<tr>
<td>II. Pressure Modes: ITime too fast or Inspiratory pressure too high.</td>
<td>II. Pressure Modes - Lengthen rise time</td>
</tr>
</tbody>
</table>
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.
<table>
<thead>
<tr>
<th>Causes of Autotriggering</th>
<th>Corrective Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Cardiac oscillations</td>
<td>I. Eliminate source: remove leaks and excess fluid</td>
</tr>
<tr>
<td>II. Air leak/ Fluid in circuit</td>
<td>II. Switch from flow to pressure sensor</td>
</tr>
<tr>
<td>III. Breath trigger too sensitive</td>
<td>III. Decrease sensitivity of trigger</td>
</tr>
</tbody>
</table>

![Graph showing auto-triggering from leak](image)

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

Pre- mature cycling:

Also known as breath stacking or double triggering,

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

Tachypneic, strong contraction of the diaphragm, patient l-time is longer than the machine’s l-time the ventilator deliver an untimely second breath.
<table>
<thead>
<tr>
<th>Causes of Premature Cycling</th>
<th>Corrective Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. The ventilator I-Time is shorter than the patients intrinsic I-Time.</td>
<td>I. VCV - Increase tidal volume - Decrease flow</td>
</tr>
<tr>
<td>II. Prolonged patient effort is sensed by the ventilator as a new breath</td>
<td>II. Pressure Modes - Increase set I-Time</td>
</tr>
<tr>
<td>III. Low tidal volume in VCV</td>
<td></td>
</tr>
</tbody>
</table>
CYCLE DYSSYNCHRONY

Delayed cycling

opposite of premature cycling

the machine’s I-time 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.
<table>
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<tr>
<th>Causes of Delayed Cycling</th>
<th>Corrective Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. The ventilator I-Time is more than the patient’s intrinsic I-Time.</td>
<td>I. VCV - Decrease tidal volume - Increase flow</td>
</tr>
<tr>
<td>II. Large tidal volumes in VCV</td>
<td>II. Pressure Modes - Decrease set I-Time</td>
</tr>
<tr>
<td>III. Long set I-time in PCV</td>
<td></td>
</tr>
</tbody>
</table>

The image depicts a ventilator interface with various settings and parameters, which can be used to adjust the ventilator settings according to the corrective measures listed in the table.