Patient-Ventilator Dysynchrony

That which turns the breath on is called the **trigger**

Inspiratory flow

That which occurs during the breath is called the *inspiratory flow* (or the limit)

Disclosures

• Clinical consultant and clinical simulation & presentation author for IngMar Medical
• Received funding from Covidien for speaking engagements
• Received funding from Hamilton Medical for speaking engagements
• Received funding from Worrell for clinical consulting
That which turns the breath off, or ends inspiration, is called the cycle.

That which occurs after inspiration has been completed is called expiration.

Patient Scenario 1
IBW 70
ABG results
pH 7.30
PaCO2 50
PaO2 82
HCO3 20
BE -5
SaO2 97%

HR 100
BP 127/55
SpO2 100
ETCO2 34

What would you recommend at this time?
a) Increase the set P<sub>INS</sub>
b) Change to flow trigger
c) Decrease the set rate
d) Increase the T<sub>INS</sub>
e) Decrease the PEEP
When the patient begins the inspiratory effort, the pressure decreases slightly. The ventilator doesn’t detect the drop in pressure to initiate an assisted breath, detectable by a lack of inspiratory flow.

When the patient finishes the inspiratory effort and effectively exhales out, the pressure begins to increase. Flow exits the patient’s lung and travels towards the expiratory valve, observed on the expiratory arm of the flow-time scalar.

Clinical implications of ineffective efforts

- Ineffective efforts result in an increased work of breathing on the patient’s behalf
  - This is due to the patient’s employment of muscles of inspiration to expand the thoracic cage in an effort to initiate a breath

- Ineffective efforts can also result in a phenomenon of breathlessness and agitation because of the undelivered breath

Correcting ineffective trigger

- Increase the set P_{INSP}
- Change to flow trigger
- Decrease the set rate
- Increase the T_{INSP}
- Decrease the PEEP

Assessment

Trigger dysynchrony – ineffective trigger

Assessment

Trigger dysynchrony – ineffective trigger

IBW 70
ABG results
pH 7.30
PaCO_2 50
PaO_2 82
HCO_3 20
BE -5
SaO_2 97%

HR 100
BP 127/55
SpO_2 100
ETCO_2 34
Correcting ineffective trigger

**Patient Scenario 2**

**Hemodynamics**
- HR: 115
- BP: 145/92

**ABG results**
- pH: 7.47
- PaCO₂: 33
- PaO₂: 72
- HCO₃: 25
- BE: +1
- SaO₂: 96%

**Medications**
- midazolam
- fentanyl
What would you recommend at this time?

a) Decrease the set volume  
b) Increase midazolam  
c) Decrease the set rate  
d) Increase the inspiratory flow  
e) Decrease the FiO₂

**ABG results**
- pH: 7.47
- PaCO₂: 33
- PaO₂: 72
- HCO₃: 25
- BE: +1
- SaO₂: 96%

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**Assessment**
Inspiratory dysynchrony = inadequate flow

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What would you recommend at this time?

a) Decrease the set volume  
b) Increase midazolam  
c) Decrease the set rate  
d) Increase the inspiratory flow  
e) Decrease the FiO₂

**Clinical implications** of inadequate flow
The clinical implication of continued inadequate flow is an increased WOB (the area under the reference curve).

In addition, there is an phenomenon of breathlessness.

If inadequate flow is recognized while using CMV Volume, it is corrected by increasing the peak inspiratory flow rate.

Correcting inadequate flow:

- Decrease the set volume (a)
- Increase midazolam (b)
- Decrease the set rate (c)
- Increase the inspiratory flow (d)
- Decrease the FiO₂ (e)

Patient Scenario 2

Continued one hour later

<table>
<thead>
<tr>
<th>IBW</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemodynamics</td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>124</td>
</tr>
<tr>
<td>BP</td>
<td>152/95</td>
</tr>
<tr>
<td>ABG results</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7.47</td>
</tr>
<tr>
<td>PaCO₂</td>
<td>33</td>
</tr>
<tr>
<td>PaO₂</td>
<td>72</td>
</tr>
<tr>
<td>HCO₃⁻</td>
<td>25</td>
</tr>
<tr>
<td>BE</td>
<td>+1</td>
</tr>
<tr>
<td>SaO₂</td>
<td>96%</td>
</tr>
<tr>
<td>Medications</td>
<td>midazolam, fentanyl</td>
</tr>
<tr>
<td>PP</td>
<td>25</td>
</tr>
</tbody>
</table>
What would you recommend at this time?

- Increase the set volume
- Increase midazolam
- Increase the set rate
- Increase the inspiratory flow
- Change to CMV-Pressure

**ABG results**
- pH 7.47
- PaCO₂ 33
- PaO₂ 72
- HCO₃ 25
- BE +1
- SaO₂ 96%

---

**Correcting inadequate flow**

- If inadequate flow is recognized while using CMV Volume, it is corrected by increasing the peak inspiratory flow rate
- To correct continued inadequate flow, the change to a pressure-limited mode of ventilation may be helpful
  - Inspiratory flow is variable in pressure-limited modes
**Patient Scenario 3**

<table>
<thead>
<tr>
<th>Mode</th>
<th>CMV Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>FiO₂</td>
<td>0.30</td>
</tr>
<tr>
<td>PEEP</td>
<td>5</td>
</tr>
<tr>
<td>set RR</td>
<td>10</td>
</tr>
<tr>
<td>total RR</td>
<td>32</td>
</tr>
<tr>
<td>set flow</td>
<td>75</td>
</tr>
<tr>
<td>set V₇</td>
<td>500 (6.7ml/kg)</td>
</tr>
<tr>
<td>Vₑ</td>
<td>21.8</td>
</tr>
<tr>
<td>PIP</td>
<td>45</td>
</tr>
<tr>
<td>PP</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Hemodynamics**

- pH: 7.52
- PaCO₂: 29
- PaO₂: 102
- HCO₃: 25.2
- BE: +1.8

**Pharmacology**

- fentanyl
- midazolam
- norepinephrine
- vasopressin
- milrinone

**Subjective / Objective**

- accessory muscle use
- agitated

---

**What would you recommend at this time?**

- a) Decrease the trigger sensitivity
- b) Increase the inspiratory flow
- c) Increase the set volume
- d) Decrease the respiratory rate
- e) Decrease the set volume

---

**What would you recommend at this time?**

- a) Decrease the trigger sensitivity
- b) Increase the inspiratory flow
- c) Increase the set volume
- d) Decrease the respiratory rate
- e) Decrease the set volume
• Premature cycling or “double-triggering”
  • Caused by a dysynchrony between the patient’s neural inspiratory time and the ventilator’s inspiratory time
    1. The ventilator has cycled the inspiratory phase (delivered the set volume)
    2. However, the patient continues to inspire and expand their thoracic cage
    3. The pressure / flow in the circuit is thereby decreased and an additional breath is triggered without exhaling the previous

• In addition to the graphical presentation used to identify premature cycling, the exhaled $V_T$ will read 0 ml for the breaths that were not exhaled followed by a “doubled volume”

• The clinical implications of severe cycle dysynchrony can be profound if the intention is to volume limit a patient who has ARDS
The inherent problem in a cycle dysynchrony is that the ventilator’s inspiratory time is shorter than the patient’s inspiratory time.

To correct the problem, the ventilator’s inspiratory time needs to be lengthened to match the patient’s neural inspiratory time.

In CMV Volume, the flow can be decreased OR
In CMV Volume, the volume can be increased.

Correcting premature cycling

- Decrease the trigger sensitivity
- Increase the inspiratory flow
- Increase the set volume
- Decrease the respiratory rate
- Decrease the set volume

<table>
<thead>
<tr>
<th>Mode</th>
<th>VC</th>
<th>pH</th>
<th>PaCO₂</th>
<th>PaO₂</th>
<th>HCO₃⁻</th>
<th>BE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>7.52</td>
<td>29</td>
<td>102</td>
<td>25.2</td>
<td>+1.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hemodynamics</th>
<th>Pharmacology</th>
<th>Subjective / Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR 125</td>
<td>fentanyl</td>
<td>accessory muscle use</td>
</tr>
<tr>
<td>BP 98/60</td>
<td>midazolam</td>
<td>agitated</td>
</tr>
<tr>
<td></td>
<td>norepinephrine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>vasopressin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>milrinone</td>
<td></td>
</tr>
</tbody>
</table>

- fentanyl
- midazolam
- norepinephrine
- vasopressin
- milrinone
- accessory muscle use
- agitated
**Patient Scenario 3**

*Ten minutes later*

<table>
<thead>
<tr>
<th>Mode</th>
<th>Volume-cycled</th>
</tr>
</thead>
<tbody>
<tr>
<td>FiO₂</td>
<td>0.50</td>
</tr>
<tr>
<td>PEEP</td>
<td>5</td>
</tr>
<tr>
<td>set RR</td>
<td>10</td>
</tr>
<tr>
<td>total RR</td>
<td>24</td>
</tr>
<tr>
<td>set flow</td>
<td>75</td>
</tr>
<tr>
<td>set V₆</td>
<td>600 (ml/kg)</td>
</tr>
<tr>
<td>V₆</td>
<td>14.8</td>
</tr>
<tr>
<td>PIP</td>
<td>32</td>
</tr>
<tr>
<td>PP</td>
<td>19</td>
</tr>
</tbody>
</table>

**Hemodynamics**

- HR 102
- BP 102/71

**Pharmacology**

- Fentanyl
- Midazolam
- Norepinephrine
- Vasopressin
- Milrinone

**Subjective / Objective**

- Accessory muscle use
- Agitated

### What would you recommend at this time?

- a) Increase the set volume
- b) Change to spontaneous mode & wean to extubate
- c) Decrease the inspiratory flow
- d) Maintain settings
- e) Increase midazolam
Assessment
Cycle dysynchrony – premature cycling

severe cycle dysynchrony

moderate cycle dysynchrony

Assessment
Cycle dysynchrony – premature cycling

mild cycle dysynchrony

severe cycle dysynchrony

moderate cycle dysynchrony

mild cycle dysynchrony
Assessment
Cycle dysynchrony – premature cycling

Clinical implications of premature cycling

Increased WOB

Correcting premature cycling
• To correct the problem, the ventilator’s inspiratory time needs to be lengthened to match the patient’s neural inspiratory time
• In CMV Volume, the flow can be decreased OR
• In CMV Volume, the volume can be increased

What would you recommend at this time?

Patient Scenario 4

<table>
<thead>
<tr>
<th>Mode</th>
<th>VC</th>
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</thead>
<tbody>
<tr>
<td>FIO2</td>
<td>0.50</td>
</tr>
<tr>
<td>PEEP</td>
<td>5</td>
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<tr>
<td>set RR</td>
<td>10</td>
</tr>
<tr>
<td>total RR</td>
<td>24</td>
</tr>
<tr>
<td>set flow</td>
<td>75</td>
</tr>
<tr>
<td>set Vt</td>
<td>600 (8ml/kg)</td>
</tr>
<tr>
<td>Vt</td>
<td>14.8</td>
</tr>
<tr>
<td>BP</td>
<td>102/71</td>
</tr>
<tr>
<td>PIP</td>
<td>32</td>
</tr>
<tr>
<td>PP</td>
<td>19</td>
</tr>
<tr>
<td>hemodynamics</td>
<td>pharmacology</td>
</tr>
<tr>
<td>HR</td>
<td>102</td>
</tr>
<tr>
<td>midazolam</td>
<td></td>
</tr>
<tr>
<td>norepinephrine</td>
<td></td>
</tr>
<tr>
<td>vasopressin</td>
<td></td>
</tr>
<tr>
<td>milrinone</td>
<td></td>
</tr>
<tr>
<td>midazolam</td>
<td></td>
</tr>
<tr>
<td>fentanyl</td>
<td></td>
</tr>
<tr>
<td>midazolam</td>
<td></td>
</tr>
<tr>
<td>norepinephrine</td>
<td></td>
</tr>
<tr>
<td>vasopressin</td>
<td></td>
</tr>
<tr>
<td>milrinone</td>
<td></td>
</tr>
<tr>
<td>accessory muscle use</td>
<td></td>
</tr>
<tr>
<td>agitation</td>
<td></td>
</tr>
</tbody>
</table>
**Assessment**
Expiratory dysynchrony – air trapping → auto-PEEP

- Expiratory hold to measure auto-PEEP
- Air-trapping or auto-PEEP can be difficult to measure quantitatively in the clinical setting

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.29</td>
</tr>
<tr>
<td>PaCO₂</td>
<td>53</td>
</tr>
<tr>
<td>PaO₂</td>
<td>72</td>
</tr>
<tr>
<td>HCO₃</td>
<td>25</td>
</tr>
<tr>
<td>BE</td>
<td>+1</td>
</tr>
<tr>
<td>SaO₂</td>
<td>95%</td>
</tr>
</tbody>
</table>

**What would you recommend at this time?**

- Decrease the volume
- Increase the inspiratory flow
- Decrease the PEEP
- Decrease the respiratory rate
- Change to a flow trigger

**Expiratory dysynchrony – air trapping → auto-PEEP**

- If expiratory flow does not return to baseline, air-trapping is present
Assessment
Expiratory dysynchrony → air trapping → auto-PEEP

- If the area under the expiratory flow curve is less than that of the inspiratory flow, then a degree of air trapping is present

\[
\text{Area} = \text{L/min} \times \text{sec} \\
\text{Area} = \text{L/sec} \times \text{sec} \\
\text{Area} = \text{Liters}
\]

Clinical implications of air-trapping/auto-PEEP

- Air-trapping → auto-PEEP can cause:
  1) Increased work of breathing due to difficulty in triggering (ineffective triggering)
  2) Decreased cardiac output and blood pressure

Assessment
Expiratory dysynchrony → air trapping → auto-PEEP

- If the area under the expiratory flow curve is less than that of the inspiratory flow, then a degree of air trapping is present

Correcting air-trapping/auto-PEEP

- To correct auto-PEEP the expiratory time must be lengthened
  - Expiratory time can be increased indirectly by decreasing the TI in the appropriate manner dependent on the mode of ventilation
  - Expiratory time can be increased directly by decreasing the respiratory rate
    - If the patient is assisting above the set respiratory rate then pharmacological means may be necessary
    - If excessive expiratory time is required due to obstructed expiratory flow, then bronchodilator therapy should also be instituted
Correcting air-trapping/auto-PEEP

**Patient Scenario 5**

What would you recommend at this time?

- pH 7.29
- PaCO₂ 53
- PaO₂ 72
- HCO₃ 25
- BE +1
- SaO₂ 95%

| a) Decrease the volume |
| b) Increase the inspiratory flow |
| c) Decrease the PEEP |
| d) Decrease the respiratory rate |
| e) Change to a flow trigger |

Mode  | PS  | PS  |
--- | --- | --- |
FiO₂  | 0.30 | 0.30 |
PEEP  | 5 | 5 |
Pinsp (PS) | 10 | 10 |

**Hemodynamics**

- HR 135
- BP 142/91

**Pharmacology**

- fentanyl
- midazolam (PRN)

IBW 60 kg

<table>
<thead>
<tr>
<th>Mode</th>
<th>PS</th>
<th>PS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FiO₂</td>
<td>0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>PEEP</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Pinsp (PS)</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>pH</td>
<td>7.43</td>
<td>7.43</td>
</tr>
<tr>
<td>PaCO₂</td>
<td>32</td>
<td>32</td>
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<tr>
<td>PaO₂</td>
<td>86</td>
<td>86</td>
</tr>
<tr>
<td>HCO₃</td>
<td>18.1</td>
<td>18.1</td>
</tr>
<tr>
<td>BE</td>
<td>-6.2</td>
<td>-6.2</td>
</tr>
<tr>
<td>IBW</td>
<td>60 kg</td>
<td>60 kg</td>
</tr>
</tbody>
</table>
What would you recommend at this time?

A. Decrease the pressure support
B. Add bronchodilator to management plan
C. Increase the pressure support
D. Maintain current settings
**Patient Scenario 6**

**Mode** | **PS** | **FiO₂** | **PEEP** | **P_{NSW} (PS)** | **pH** | **PaCO₂** | **PaO₂** | **HCO₃⁻** | **BE** | **SaO₂**
---|---|---|---|---|---|---|---|---|---|---
CMV | - Volume-targeted pressure | 0.50 | 500 | 5 | 0.80 | 7.33 | 49 | 72 | 25 | 1 | 95%

What would you recommend at this time?

**a)** Decrease the target volume  
**b)** Increase the inspiratory time  
**c)** Change to CMV - pressure  
**d)** Decrease the inspiratory time  
**e)** Maintain settings
What would you recommend at this time?

a) Decrease the target volume  
b) Increase the inspiratory time  
c) Change to CMV - pressure  
d) Decrease the inspiratory time  
e) Maintain settings

Assessment  
Inspiratory dysynchrony – inadequate flow / pressure

• In the CMV volume-targeted, pressure mode, the ventilator measures the exhaled volume and then adjusts the inspiratory pressure on the subsequent breath, either up or down, to achieve a targeted tidal volume

However, when patients begin to become distressed their inspiratory effort will initially increase
However, when patients begin to become distressed their inspiratory effort will initially increase.

The ventilator will allow the flow and volume to be inspired by the patient because it is variable.

This typically results in a larger-than-target exhaled volume.

In this mode, the ventilator will decrease the inspiratory pressure on the next breath to maintain the target volume.

- The unintended consequence is that a decreased inspiratory pressure results in a decreased required flow from the ventilator.
Clinical implications of inadequate flow/pressure

- This decrease in required flow increases the patient’s work of breathing as they try to obtain their demand flow.
- A vicious cycle is started as the ventilator decreases its level of support when the patient actually requires more support.

Correcting inadequate flow/pressure

1. While maintaining the CMV Volume-targeted, pressure mode, you can decrease the $T_i$
   - Decreasing $T_i$ will decrease the $V_r$ on the first breath of the sequence.
   - As a result of the decreased $V_r$, the ventilator will increase the pressure, and therefore the required flow, to maintain the target volume.

2. While maintaining the CMV Volume-targeted, pressure mode, you can also increase the $V_r$.
   - Increasing the target volume will require more pressure, and therefore more demand flow.

3. Change the mode to CMV Pressure.
   - You will be required to set an inspiratory pressure that does not vary.
   - This set pressure will also ensure a required flow delivery.

4. Change the mode to CMV Volume.
   - Changing to this mode would require you to set a flow rate.
   - A set flow rate would alleviate the work of breathing, provided it is adequate.
Assessment
Expiratory dysynchrony – air-trapping

Patient Scenario 7

<table>
<thead>
<tr>
<th>Mode</th>
<th>CMV pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>FiO₂</td>
<td>0.50</td>
</tr>
<tr>
<td>PEEP</td>
<td>5</td>
</tr>
<tr>
<td>set RR</td>
<td>14</td>
</tr>
<tr>
<td>total RR</td>
<td>32</td>
</tr>
<tr>
<td>T₁</td>
<td>0.45</td>
</tr>
<tr>
<td>P_insp</td>
<td>22</td>
</tr>
<tr>
<td>exh V₁</td>
<td>450-750</td>
</tr>
<tr>
<td>V₅</td>
<td>11.2</td>
</tr>
</tbody>
</table>

hemodynamics
- Hemodynamics
- Pharmacology
- Subjective / Objective

- HR 85
- BP 124/83
- propofol
- No accessory muscle use
**Assessment**
Cycle dysynchrony – premature cycling

- Premature cycling or “double-triggering”
  - Caused by a dysynchrony between the patient’s neural inspiratory time and the ventilator’s inspiratory time
    1. The ventilator has cycled the inspiratory phase (set inspiratory time)
    2. However, the patient continues to inspire and expand their thoracic cage
    3. The pressure / flow in the circuit is thereby decreased and an additional breath is triggered without exhaling the previous

**What would you recommend at this time?**

a) Decrease the inspiratory time
b) Increase propofol
c) Increase the inspiratory pressure
d) Increase the inspiratory time
e) Decrease the trigger sensitivity

- In addition to the graphical presentation used to identify premature cycling, the exhaled $V_T$ will read very low for the breaths that were not exhaled followed by a “very large volume”
<table>
<thead>
<tr>
<th>Assessment</th>
<th>Cycle dysynchrony – premature cycling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>severe cycle dysynchrony</td>
</tr>
<tr>
<td></td>
<td>moderate cycle dysynchrony</td>
</tr>
<tr>
<td></td>
<td>mild cycle dysynchrony</td>
</tr>
</tbody>
</table>
• To correct the problem, the ventilator’s inspiratory time needs to be lengthened to match the patient’s neural inspiratory time

• In CMV pressure the inspiratory time can be directly increased

Patient Scenario 8

<table>
<thead>
<tr>
<th>Mode</th>
<th>CMV-P</th>
</tr>
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<tbody>
<tr>
<td>FiO₂</td>
<td>0.50</td>
</tr>
<tr>
<td>PEEP</td>
<td>5</td>
</tr>
<tr>
<td>set RR</td>
<td>14</td>
</tr>
<tr>
<td>total RR</td>
<td>32</td>
</tr>
<tr>
<td>T₁</td>
<td>0.45</td>
</tr>
<tr>
<td>P_{INSP}</td>
<td>22</td>
</tr>
<tr>
<td>exh Vₜ</td>
<td>450-750</td>
</tr>
<tr>
<td>Vₑ</td>
<td>11.2</td>
</tr>
</tbody>
</table>

Hemodynamics
- HR: 85
- BP: 124/83

Pharmacology
- * propofol

Subjective / Objective
- No accessory muscle use

- Decrease the inspiratory time
- Increase propofol
- Increase the inspiratory pressure
- Increase the inspiratory time
- Decrease the trigger sensitivity
• 53 year old female (IBW 58 kg)
• Admitted for perforated bowel
• Emergent exploratory laparotomy for bowel repair on hospital day #1
• Returned to operating room on hospital day #7 for exploratory laparotomy due to accumulation of intra-abdominal abscess
• Post-operatively, the patient was assessed

<table>
<thead>
<tr>
<th>Hemodynamics</th>
<th>Pharmacology</th>
<th>Subjective / Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR 132</td>
<td>Fentanyl</td>
<td>Accessory muscle use</td>
</tr>
<tr>
<td>BP 91/60</td>
<td>Propofol</td>
<td>Agitated</td>
</tr>
<tr>
<td>BT 39.2°C</td>
<td>Norepinephrine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vasopressin</td>
<td></td>
</tr>
</tbody>
</table>

- pH 7.28
- PaCO₂ 58
- PaO₂ 67
- HCO₃ 16.4
- BE -8.3
- SvO₂ 53%
- Lactate 7.4
- WBC 21.2
What would you recommend at this time?

- Increase the set volume
- Decrease the inspiratory flow
- Increase the set respiratory rate
- Change to CMV pressure mode
- Administer vecuronium

Assessment
Cycle dysynchrony – premature cycling

- Septic shock / hypotension
- ARDS
Correcting premature cycling

- To correct the problem, the ventilator’s inspiratory time needs to be lengthened to match the patient’s neural inspiratory time
- In volume A/C, the flow can be decreased OR
- In volume A/C, the volume can be increased

OR

- To correct the problem, the patient’s neural inspiratory time needs to be shortened to match the ventilator’s inspiratory time with sedation

The patient was volume resuscitated over the next several hours according to sepsis resuscitation guidelines and antibiotics were started

Six hours later the patient was reassessed

<table>
<thead>
<tr>
<th>Hemodynamics</th>
<th>Pharmacology</th>
<th>Subjective / Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR 132</td>
<td>fentanyl</td>
<td>accessory muscle use</td>
</tr>
<tr>
<td>BP 91/60</td>
<td>propofol</td>
<td>agitated</td>
</tr>
<tr>
<td>BT 39.2°C</td>
<td>norepinephrine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>vasopressin</td>
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</table>

<table>
<thead>
<tr>
<th>Subject</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
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</tr>
<tr>
<td>PaCO₂</td>
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</tr>
<tr>
<td>PaO₂</td>
<td>67</td>
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<td>7.4</td>
</tr>
<tr>
<td>WBC</td>
<td>21.2</td>
</tr>
</tbody>
</table>
What would you recommend at this time?

- Increase the set volume
- Put the patient into the prone position
- Increase the set respiratory rate
- Change to CMV pressure mode
- Change to airway pressure release
- Change to high frequency oscillatory ventilation
**Summary**

- **Inspiratory dysynchrony**
- **Expiratory dysynchrony**
- **Cycle dysynchrony**
- **Trigger dysynchrony**

**Continuous Mandatory Ventilation**
- CMV Volume
- CMV Pressure
- CMV Volume-Targeted Pressure

**Continuous Spontaneous Ventilation**
- csv CPAP
- csv Pressure Support
- csv Volume-Targeted Pressure

**Hemodynamics**
- HR: 118
- BP: 94/63
- BT: 39.2°C

**Pharmacology**
- Fentanyl
- Propofol
- Vecuronium (PRN)
- Norepinephrine
- Vasopressin
- N-acetylcysteine

**Subjective / objective**
- Accessory muscle use
- Agitated

**Respiratory Settings**
- Mode: VC
- FiO2: 1.0
- PEEP: 20
- Set RR: 35
- Total RR: 35
- Set flow: 90
- Set V1: 350 (l/min/kg)
- V2: 21.8
- PIP: 48
- PP: 34
- MAP: 30
- RM at 40cmH2O 4-5 times/hr

**Gas Exchange**
- pH: 7.17
- PaCO2: 72
- PaO2: 67
- HCO3: 19.8
- BE: -5.3
- SvO2: 62%
- Lactate: 4.1

**Patient Status**
- HR: 118
- BP: 94/63
- BT: 39.2°C

**Interventions**
- Increase the set volume
- Put the patient into the prone position
- Increase the set respiratory rate
- Change to CMV pressure mode
- Change to airway pressure release
- Change to high frequency oscillatory ventilation

**Blood Gas Values**
- pH: 7.17
- PaCO2: 72
- PaO2: 67
- HCO3: 19.8
- BE: -5.3
- SvO2: 62%
- Lactate: 4.1