APRV – LTV STUDY METARULES

Goal: Maintain a mean airway pressure that recruits and maintains end expiratory lung volume. Also follow release volumes and keep release volumes between 4-8cc/kg with target 6.0cc/kg

- All patients should have an ABG at the time of randomization and generally every 2 hours unless contraindicated
- Protocol will be run within 30 minutes of new ABG’s
- Use PaO2 if available, only use SPO2 if PaO2 more than 30 minutes old.
- Paper and computer charting must be done every two hours and whenever a change is made. When the patient is taken off the protocol, the paper charting will be turned in to a member of the research team.
- Treat correctable problems before failing patient or reassessing:
  1. Anxiety, pain, delirium
  2. Acute bronchospasm
  3. Mucus plug
  4. Excessive sedation
  5. Patient position
  6. Ventilator circuit problem
- Contact the attending MD or house officer when the following conditions occur:
  1. P high has been increased 6 cmH2O
  2. P high at 28 cm H2O.
  3. FiO2 increased 30%.
  4. P Low and P high are closer than 5mmHg apart
- % of peak expiratory flow will be maintained at 50 to 75%. T low will be adjusted to maintain the % of peak expiratory flow at 50 to 75%.
- Slope is set at “0” to ensure a square waveform.
- ATC will be off until mode is CPAP.
- P low will be titrated to target release volumes
- If P high is being decreased for oxygenation Plow will decrease generally by same amount
- P high will not be increased or decreased by more than 4 cm H2O every two hours
- T high will not be increased or decreased by more than 2 seconds every two hours.
- If the patient is being paralyzed, change the mode to PRVC, use the procedure APRV to Assist Control Transition
- If the pH > 7.25 and < 7.40
  o And PCO2 > 35 follow the protocol
  o And PCO2 is 25 – 35, contact MD
- ABG recommended:
  o When ABG SpO2 and SaO2 differ by more than 5.
  o Significant change in temperature or minute volume shifting the O2 dissociation curve.
- ABG required:
- Increase or decrease T high by a total of 5 seconds.
- 6 hours if ABG SpO2 and SaO2 differ by 6.
- 6 hours when P high ≥ 25 and FiO2 >0.6
- 12 hours when FiO2 > .4 and P High ≥ 15
- 24 hours when FiO2 = .4 and P High ≤ 10.

Flow Waveform Interpretation Guide

<table>
<thead>
<tr>
<th>Waveform</th>
<th>Interpretation / Definition</th>
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<tr>
<td>0. Sinusoidal</td>
<td>Normal flow waveform where the inspiratory flow is semi - elliptical, or a half-moon shape. Generally, the base of the waveform is wider than the amplitude. Peak flows usually remain &lt; 40 Lpm. Sinusoidal waveforms indicate <strong>good recruitment with minimal elastic WOB</strong>.</td>
</tr>
<tr>
<td>1. Whale’s Tooth</td>
<td>Round at the top and the amplitude is usually greater than the width of the base. Minimal tapering is observed from the bottom to the top of the inspiratory waveform. Peak flow usually remains &lt; 50 – 60 LPM. Suggests <strong>mild to moderate elastic WOB</strong>.</td>
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<tr>
<td>2. Shark’s Tooth</td>
<td>Triangular in shape where the amplitude of the waveform somewhat exceeds the width of the base. Peak flows usually &lt; 70 LPM. Suggests <strong>moderate to substantial elastic WOB</strong>.</td>
</tr>
<tr>
<td>3. Canine Spiked</td>
<td>Tall narrow waveforms with significant tapering from bottom to top. Peak Flows usually &gt; 70 LPM. Suggests <strong>severe elastic WOB</strong>.</td>
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</tbody>
</table>
APRV LTV Protocol

102. Initial APRV Settings

A01
Set P high at current Plateau pressure.
If plateau unobtainable – set P high at mean airway pressure plus 3

A02
Set P high at current Pressure Support level

A03
Set P low at 5 cmH2O
Increase in increments of 2 cmH2O
(maximum P low of 12 cmH2O) to achieve APRV release tidal volumes
of 5 – 7 ml/kg IBW

S01
Currently on A/C, PRVC, SIMV, VC+

S02
Total VR >= 30

S03
Total VR = 21 – 29

S04
Total VR <= 20

S05
Total VR > 30

Note:
Maintain a minimum of 5 cmH2O between P high and P low.

Setting Min Max
T high 3 sec 12 sec
T low .5 sec 1.8 sec
P high 5 30
P low 5 12

A04
Set T high at 4 seconds

A05
Set T high at 5 seconds

A06
Set T high at 6 seconds

A07
Set T low at 0.8 sec
Adjust to maintain termination flow of peak expiratory flow at 50 – 75%

A08
Set FIO2 at current FIO2
Set slope to 0
Set ATC off
ABG in 30 minutes

R01
Return to CORE
APRV LTV Protocol
Ventilation Cells

F103. pH Adjustment

S01 New ABG?
- No → R01 Return to CORE
- Yes → S02 pH < 7.25
  - Yes → S05 Decrease in T High with pH < 7.25 in last 2 hours?
    - Yes → S06 pH increased 0.5?
      - No → A06 Decrease T High 1 second to a minimum of 3 seconds and Increase P high 2 cmH2O to a maximum of 30 cmH2O Call Attending MD
      - Yes → S07 pH >= 7.20?
        - No → A04 Decrease T High 1 second to a minimum of 3 seconds Increase P high 2 cmH2O to a maximum of 30 cmH2O ABG in one hour Call Attending MD
        - Yes → A05 Maintain ABG in one hour
  - No → S03 pH > 7.42
    - Yes → A01 Increase T high 2 seconds to a maximum of 12 seconds
    - No → S04 T high <= 5 seconds
      - No → A02 Continue to monitor
      - Yes → A03 Decrease T high 1 second to a minimum of 3 seconds

NOTE
If the pH is between 7.25 and 7.40:
- PCO2 > 35 follow the protocol
- PCO2 25 – 35, contact MD

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<td>30</td>
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<td>P low</td>
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<td>12</td>
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Note:
*Maintain a minimum of 5 cmH2O between P high and P low.

06/24/2013
F104. Work of Breathing Assessment

S01: WOB score increased by 3 or more and/or ETCO2 increase > 5 mmHg

S02: T high < 5 seconds

S03: P high 20 - 29

S04: T high ≥ 5 seconds

S05: P high ≤ 20

S06: T high < 5

S07: T high > = 5 seconds

S08: T High > = 5 seconds

A01: Increase P high by 4 cmH2O to a maximum of 30 cmH2O
Maintain T high
Reassess WOB score in 15 minutes

A02: Increase P high by 4 cmH2O to a maximum of 30 cmH2O
Increase T high by 0.5 second to a maximum of 12 seconds
Reassess in 15 minutes

A03: Increase P high by 2 cmH2O to a maximum of 30 cmH2O
Maintain T high
Reassess WOB score in 15 minutes

A04: Increase P high
By 2 cmH2O to a maximum of 30 cmH2O
Reassess in 15 minutes

A05: Decrease T high .5 seconds to a minimum of 3 seconds.
Maintain P high
Reassess WOB score in 15 minutes

A06: Decrease T high .5 seconds to a minimum of 3 seconds.
Maintain P high
Reassess WOB score in 15 minutes

R01: Return to CORE

**Note:**
*Do not increase or decrease P high by more than 4 cm H2O every 2 hours.
*Do not increase or decrease T high by more than 2 seconds every 2 hours.
*Maintain a minimum of 5 cmH2O between P high and P low.

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06/24/2013
F105a. Improve Oxygenation

Do not wean P High if VT is less than 6 ml/kg

After intervention based on the cell Return to CORE

SpO2 < 87 or paO2 < 55

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Call MD
F105b. Optimize Oxygenation

Do not wean P High if VT is less than 6 ml/kg

After intervention based on cell Return to Core

### SpO2 > 93 or paO2 > 68

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<tr>
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**F105c. Maintain Oxygenation**

After intervention based on cell, Return to Core

**SpO2 88 to 93 or paO2 55 to 68**

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F106. P Low Adjustment

A01 Maintain P low

S01 Average release VT from Ventilator charting = 5 – 7 ml/kg IBW

No

S05 P low < or = 5 cmH2O

No

A02 Decrease P low by 2 cmH2O to a minimum of 5 cmH2O Reassess in 10 minutes

Yes

A05 Increase P high 2 cmH2O to a maximum of 30 cmH2O

A06 Decrease P high by 2 cmH2O Decrease P low by 2 cmH2O

S02 VT < 5 ml/kg IBW

Yes

S03 P low = 12cmH2O?

Yes

A03 Decrease P high by 2 cmH2O(Maintain a minimum of 5 cmH2O between P high and P low)

No

A04 Increase P low by 2 cmH2O to a maximum of 12 cmH2O Reassess in 2 hours

No

S04 P low < 12 cmH2O

Return to CORE

Reassess:
Complete a ventilator assessment in the computer. If the release tidal volume is > 7 ml/kg IBW or less than 5 ml/kg IBW. Adjust P low according to above flow diagram.

Note:
*Maintain a minimum of 5 cmH2O between P high and P low

Setting | Min | Max
--- | --- | ---
T high | 3 sec | 12 sec
T low | .5 sec | 1.8 sec
P high | 5 | 30
P low | 5 | 12

06/24/2013
F107. P High and T High Titration

**A01**
Maintain T high
Decrease P high by 2 cmH2O to a minimum of 10 cmH2O
Decrease P low by 2 cmH2O to a minimum of 5 cmH2O
Reassess in 15 minutes

**A02**
Increase T high by 1 second to a maximum of 12 seconds
Decrease P high by 2 cmH2O to a minimum of 10 cmH2O.
Decrease P low by 2 cm H2O to a minimum of 5 cmH2O
Reassess in 15 minutes

**A03**
Maintain P high
Increase T high 1 second to a maximum of 12 seconds
Reassess in 15 minutes

**A04**
Increase T high by 1 second to a maximum of 12 seconds
Decrease P high by 2 cmH2O to a minimum of 10 cmH2O.
Decrease P low by 2 cm H2O to a minimum of 5 cmH2O
Reassess in 15 minutes

**S01**
FIO2 <= 0.6
Yes → F105
Go to Oxygenation Table
No

**S02**
T high >= 12 seconds and P high <= 10 cmH2O
Yes → F108
Go to CPAP weaning
No →

**S03**
P high > 20 cmH2O
Yes →

**S04**
T high < 8 seconds
Yes →

**S05**
T high < 8 seconds
No

**S06**
P high > 20 cmH2O
Yes

**S07**
P low <= 5 cmH2O
Yes

**S08**
P low > 5 cmH2O
No →

**R01**
Return to CORE

**Note:**
* Do not increase or decrease P high by more than 4 cm H2O every 2 hours.
* Do not increase or decrease T high by more than 2 seconds every 2 hours.
* Maintain a minimum of 5 cmH2O between P high and P low.

**Setting** | **Min** | **Max**
--- | --- | ---
T high | 3 sec | 12 sec
T low | .5 sec | 1.8 sec
P high | 10 | 30
P low | 5 | 12

**Note:**
If instruction from F106 P Low adjustment is to increase P low 2 cmH2O and instruction from above is to decrease P High and P low, Only decrease the P High.
APRV LTV

F108 Weaning Protocol to Extubation

Pt currently on CPAP?

Yes

S01
FI02 input <= 0.4 and P High <= 12 and T High >= 12 sec
And time is between 06:00 and 10:00 a.m.

No

F08 Wean P high and T high

Yes

Set CPAP = 8 cm H2O
FI02 = current FI02
Set ATC 100%
Reassess in 20 minutes

A01

No

S02
pH < 7.30

No

S03
SpO2 < 92%

Yes

A02
Change mode to APRV
Set P high = 12 cmH2O
Set T high = 6 sec
ABG in 20 minutes

No

S04
FI02 <= .5 and CPAP <= 10 cmH2O

No

S07
WOB score increased by 3 or more

Yes

A06
Change mode to APRV
Set P high = 12 cmH2O
Set T high = 6 sec
ABG in 20 minutes

No

A07
Increase CPAP to 10 cmH2O
Reassess in 20 minutes

S05
SpO2 < 98%

No

S06
CPAP < 10

Yes

A08
Increase FI02 0.1

No

A09
Increase CPAP 2 cmH2O

S09
CPAP <= 5

No

A05
Consider extubation

Yes

R01
Return to CORE

S08
FI02 > .4

No

A03
Decrease FI02 by 0.1
Reassess in 2 hours

Yes

A04
Decrease CPAP by 1 cmH2O

Spontaneous Breathing Goals:
1. SpO2 > 90% or PaO2 >55
2. Average spontaneous tidal volume > 4 ml/kg IBW
3. Spontaneous VR < = 35 bpm
4. pH > = 7.30 if measured

Reassess:
1. WOB = work of breathing score
2. ETCO2
3. SpO2
4. ABG if done

Treat correctable problems before
failing patient back to APRV or
reassessing:
1. Anxiety, pain, delirium
2. Acute bronchospasm
3. Mucus plug
4. Excessive sedation
5. Patient position
6. Ventilator circuit problem