Airway Pressure Release Ventilation (APRV) Management

Definition:

Airway Pressure Release Ventilation: An elevated CPAP level with timed pressure releases. This mode allows for spontaneous breathing.

Indications:

1. Acute lung injury (ALI)/ARDS
2. Diffuse pneumonia
3. Atelectasis requiring >.50 FiO_2
4. Tracheo-esophageal fistula

Initial settings: (see Figure 1)

1. P_{high} at the $P_{plateau}$
   (or desired P_{mean} + 3 cmH_2O)
   Try to keep P_{high} below 35 cmH_2O
2. T_{high} at 4.5-6 seconds
3. P_{low} at 0 (to optimize expiratory flow)
4. T_{low} at 0.5 to 0.8 second (see Waveforms)
5. Automatic tube compensation (ATC): on if spontaneously breathing

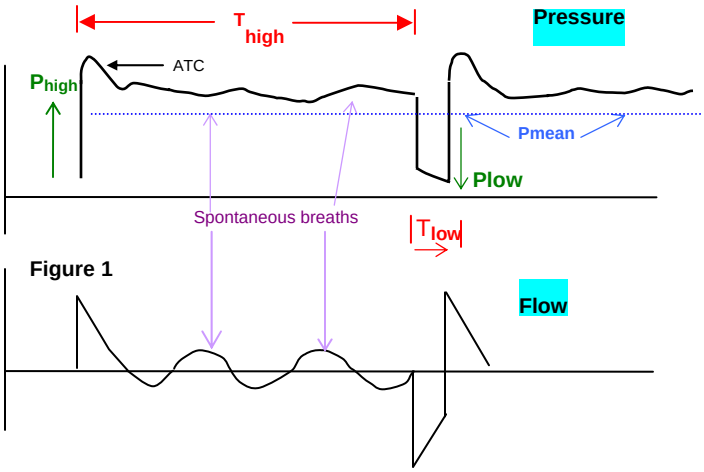


Figure 1

Like Pressure Control- Inverse Ratio Ventilation (PC-IRV), APRV utilizes a long "inspiratory time" (T_{high}) to recruit alveoli and optimize gas exchange. The open exhalation valve allows for spontaneous breathing during T_{high}.

Observation:
APRV should help rest the inspiratory muscles and utilize the diaphragm. Once the initial settings are applied, look for the anterior chest muscles to be used much less and the diaphragm to be doing the majority of the work. This should occur within hours after placement on APRV. The patient should be breathing more comfortably as recruitment occurs.

Note:

The earlier APRV is used, the more effective it is in recruiting the lung and the more likely it is to be tolerated. If initiating APRV late in the course of ARDS, patients sometimes will not look comfortable despite optimal APRV settings, and they may need an alternate mode.

Waveforms:

It is important to observe the Flow -Time waveform to optimize the settings. During the pressure release phase, the patient will exhale passively. Adjust the T_{low} to cut off the expiratory flow during a release at about 50% (25-75%) of peak expiratory flow rate (PEFR) (see Figure 2)

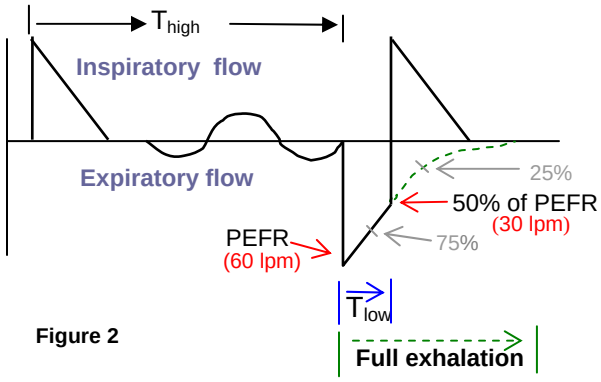
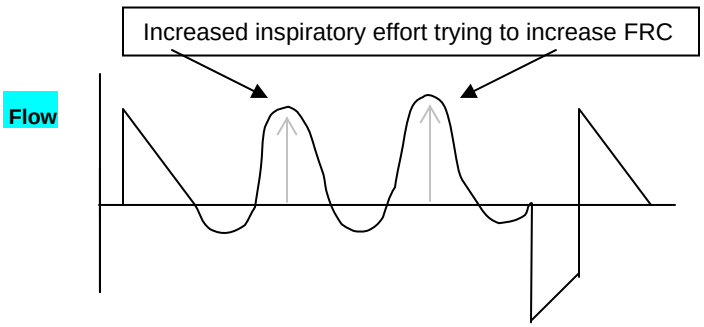


Figure 2

- **Never allow the termination of expiratory flow to go <25% of the PEFR!** This intentional intrinsic peep allows P_{low} to be set at 0 cmH_2O without causing de-recruitment.
- Generally, the T_{low} can be as short as 0.3 seconds (closer to 75% of the PEFR) in restrictive diseases and as long as 1.5 seconds (closer to 25% of the PEFR) in obstructive states.

Adjustments:

Figure 3



Adjustments continued:

1. If the patient is consistently inhaling forcefully with accessory muscles, he/she may need alveolar recruitment (see Figure 3). Options are:
   - Increase P_{high}; this will elevate the P_{mean} and encourage recruitment.
   - Decrease T_{low} only if you can maintain the flow during the release phase <75% of PEFR and the $PaCO_2$ and pH are acceptable.

2. If the patient seems to be exhaling forcefully, over-inflation may be present (see Figure 4). Options are:
   - Decrease the P_{high} in 1-2 cmH_2O increments and increase T_{high} (to maintain the same P_{mean}) and/or:
   - Increase the T_{low} (allowing more time to exhale) only if you can maintain the flow during the release phase >25% of PEFR
   - CXR should be monitored for lung over-inflation

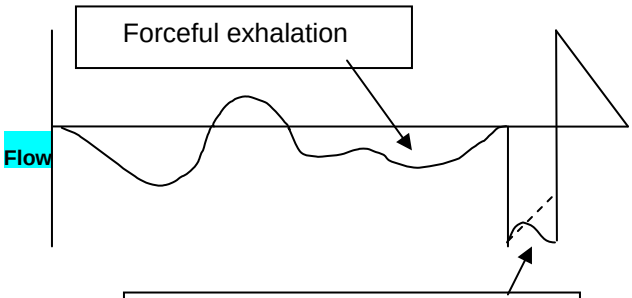


Figure 4

ABG Management

Oxygenation Options:

1. When possible: wean FiO_2 to <.50 for a SpO_2 >90% or a PaO_2 >60 torr.
2. To improve oxygenation via higher P_{mean}:
   - Increase P_{high} in increments of 2 cmH_2O
   - Decrease T_{low} to be closer to 75% PEFR

Respiratory Acidosis Options:

1. Increase P_{high} (up to 40 cmH_20) or
2. Increase T_{high} (if spontaneously breathing) in increments of 0.5 seconds up to 8 seconds (see #5).
   If $PaCO_2$ increases with this change, it *may* reflect inadequate lung volume.
   If this is the case, try increasing P_{high} to re-establish an adequate FRC.
3. Increase T_{low} to allow more time for alveolar emptying, but only if the expiratory flow of a release doesn't drop below 25% of the PEFR.
4. If further increases in T_{high} fail to drop $PaCO_2$, **you may need to do the opposite:** Decrease T_{high} (to increase the rate of releases). This will decrease the P_{mean} and oxygenation. Therefore, also increase P_{high} to maintain the P_{mean}. Maximize P_{high} and release rate up to 30 (more like PC-IRV)
5. If unable to manage the acidosis with APRV, the mode may be changed to PCV attempting to maintain the same rate and P_{mean}.

Respiratory Alkalosis Options:

1. Decrease P_{high} ($Sp0_2$ may decrease)
2. Increase T_{high} to decrease the release rate
3. Turn ATC off if no spontaneous respirations

Weaning:

When FiO_2 is titrated below .50, recruitment is maximized, and the patient is breathing spontaneously, **a continuous gradual wean** can begin by:

- Decreasing the P_{high} by 1-2 cmH_2O **and** increasing the T_{high} by 0.5 seconds for every 1 cmH_2O drop in P_{high}. This is referred to as "drop and stretch".
- "Drop and stretch" should be done every two hours or more if tolerated. As you "drop and stretch" the P_{mean} is gradually lowered, so you will need to monitor SpO_2. Changing to CPAP or dropping P_{mean} too quickly will possibly de-recruit alveoli.
- Throughout the weaning process, the patient should be closely monitored for increasing work of breathing, tachypnea, or a drop in SpO_2. If this occurs, return to the previous settings.
- When the P_{high} reaches 10 cmH_2O and the T_{high} reaches 12-15 seconds, change the mode to CPAP with PEEP at 10 and PS at 5-10 (ATC off). Slowly wean CPAP as tolerated.

The patient should be spontaneously breathing throughout this process, therefore, it is not necessary to do spontaneous breathing trials.