Protocol/ Procedure	Airway Pressure Release Ventilation (APRV)		
Division	Critical Care	**Original Date:**	April 4th, 2006
Department	Respiratory Care	**Revision Date:**	August 27, 2010
Category	Mechanical Ventilation	**Approved by:**	RC Medical Director
Locations	Intensive Care Units	**Owner:**	Scott Richey

Purpose:

Guidelines & standards for using APRV as a ventilator modality.

Synopsis:

APRV is a form of pressure ventilation, which supports spontaneous breathing on two alternating levels of CPAP "Bi-Phasic Ventilation" (a.k.a.: Bi-Level, BiPAP).
APRV switches automatically and regularly between the two operator selected levels of CPAP (pHigh & pLow /PEEP).
Cycling between the two levels of CPAP is time triggered.
APRV incorporates the "Open Breathing concept/ Floating Exhalation Valve" (the exhalation valve is never occluded completely). This allows the patient to freely inhale or exhale during the entire respiratory cycle (promoting increased patient comfort, patient/ ventilator synchrony, and decreased sedation/ analgesic requirements).

Performed By:

Staff Respiratory Therapists who have been educated to the indications, techniques, and side effects. APRV is initiated only on the order of attending or resident physicians or per protocol. All employees managing APRV are determined to be competent prior to independently initiating the modality unless clinical supervisor, preceptor, or physician is present.

Indications:

- PaO2/ FiO2 Ratio < 300.
- Bilateral infiltrates (consistent w. edema-patchy, diffuse).
- No evidence of left atrial hypertension.

Relative Contra-Indications:

- Serve COPD, emphysema
- Pneumothorax
- Blood pressure: < 90 systolic or < 60 mean
- Unilateral lung disease

Procedure:

Initial Set-up: transitioning from conventional mechanical ventilation

Required Action Steps	Supplemental Guidance
1. Set **pHigh**	▪ Set pHigh to desired or target plateau pressure (20-30 cmH2O). ▪ **Rationale-** Prevent over-distension. ▪ ***Note-*** if extra-thoracic compliance is low, consider target plateau 30-40 per physician. Calculate trans-pulmonary pressure with esophageal balloon or bladder pressure measurements.
2. Set **t-High**	▪ Four **(4)** to six **(6)** seconds. ▪ **Rationale-** allows for sustained alveolar recruitment
3. Set **p-Low**	▪ Zero **(0)** ▪ **Rationale-** Allows for a rapid peak expiratory phase, augmenting CO2 removal. Setting the p-Low above zero creates added resistance creating increased turbulent expiratory flow.
4. Set **t-Low**	▪ **0.2-0.8 seconds.** ▪ Titrate t-Low to obtain a "Peak Expiratory Flow Rate Termination Point" at 50-75% of the measured "Peak Expiratory Flow". ▪ **Rationale-** Maintains expiratory lung volume & prevents alveolar closure during the release phase.
5. Set: **Rise time, trigger, ,FIO2**	▪ Set **Rise time, trigger** per. Patient comfort & waveform analysis. ▪ Set **FiO2** per. Patients oxygen needs: PO2 60-80/ spO2 90-92%, unless Hb < 7 gm (then 95% or physician order). ***Note-*** spO2 88-90% ok if FiO2 > 60%, with Hb > 6, & mean BP > 50.
6. Alarms	▪ Set per Ventilator Standards/ Guidelines

Optimization of Settings: Improving Oxygenation

Required Action Steps	Supplemental Guidance
Titrate **t-Low**	▪ Assess the peak expiratory termination point, if it is < 50% of the measured peak expiratory flow, decrease **t-Low** to obtain a termination point up to 75% of the Peak expiratory flow. ▪ **Rationale-** to maximize end expiratory lung volume.
Increasing **pHigh**	▪ Increase in **2 to 5** cmH2O increments, while assessing patients' hemodynamic status, up to 30 cmH2O. ▪ ***Note-*** if extra-thoracic compliance is low, consider increasing to 30-40 per physician.
Increasing **t-High & pHigh** at the same time.	▪ Lengthen **t-High 1 to 2** seconds with **pHigh** titrations. ▪ **Rationale-** increases gas mixing and recruits alveoli with longer time constants. ▪ **Monitor**- Hemodynamics when titrating: poor hemodynamic response warrants assessment of vascular volume and cardiac output. Consider pharmaceutical therapeutics to increase CO.

Optimization of Settings: Decreasing PaCO2

Required Action Steps	Supplemental Guidance
Assess Sedation & Spontaneous frequency	▪ Titrate sedation to allow for spontaneous ventilation, patient should always have spontaneous efforts. ▪ Target a RASS score of -2 to zero (0). ▪ **Rationale-** ensures that the patient is contributing to total minute ventilation. Spontaneous efforts are associated with improved systemic and pre-portal organ blood flow.
Assess Expiratory Flow	▪ Assess the peak expiratory termination point it should be at 50-75% of the peak expiratory flow. ▪ If oxygenation status is stable, consider increasing **t-Low** 0.05 to 0.1 second increments to obtain a termination point equal to 50%.
Increasing Minute Ventilation	▪ Increase in **2 to 5** cmH2O increments, while assessing patients' hemodynamic status, up to 30 cmH2O. ▪ ***Note-*** if extra-thoracic compliance is low, consider increasing to 30-40 per physician. ▪ ***Consider-*** decreasing **t-High** if oxygenation status is stable, this will allow for more releases. ▪ ***Note-*** decreasing **t-High** will lower mean airway pressure and shorten exposure time, this effecting oxygenation.
PH goals	▪ > 7.25 ▪ Hypercapnia may be necessitated by **pHigh** & minute ventilation limits.

Weaning

Required Action Steps	Supplemental Guidance
FiO2	▪ Wean to PO2 60-80/ spO2 90-92%, unless Hb < 7 gm (then 95% or physician order). ▪ ***Note-*** spO2 88-90% ok if FiO2 > 60%, with Hb > 6, & mean BP > 50.
pHigh	▪ Do not wean **pHigh** until FiO2 is < 50 % & oxygenation stable at least two hours. ▪ Decrease **pHigh** only by 2 to 5 cmH2O at a time.
Wean & Stretch	▪ Decrease the **pHigh** while simultaneously increasing the **t-High**. ▪ Decrease the **pHigh** only 1 to 2 cmH2O at a time. ▪ Increase the **t-High** by 0.5 seconds, with every 1 to 2 cmH2O reductions in **pHigh**.

Monitoring:

Outcome Monitoring
Based on case managing physician, mechanical ventilation goals, patient/ventilator synchrony, sedation/analgesic use, and ventilator length of stay.

Document Management
Based on current standard documentation guidelines/policy.

Related Documents:

Policy	Ventilator Standards/ Guidelines
Job Aids	IDBW conversion charts Richmond Agitation Sedation Scale (RASS)
References	Branson, R. & Johannigman, J. (2004). **What is the Evidence Base for the Newer Ventilation Modes?** *Respiratory Care.* 49 (7):742-760. Habashi, N. (2005). **Other Approaches to Open-Lung Ventilation: Airway Pressure Release Ventilation.** *Critical Care Medicine.* 33 (30; s228-s236). Hering, R. & al. (2008). **Spontaneous Breathing During Airway Pressure Release Ventilation in Experimental Lung Injury: Effects on Hepatic Blood Flow**. *Intensive Care Medicine.* 34 (1): 523-527. Kuhlen, R. & Rossaint, R. (2002). **The Role of Spontaneous Breathing During Mechanical Ventilation.** *Respiratory Care*. 47 (3): 296 Myers, T & Macintyre, N. (2007). **Does Airway Pressure Release Ventilation Offer Important New Advantages in Mechanical Ventilator Support?** *Respiratory Care.* 52 (4): 452-457.