Providence HEALTH CARE	Department: **Respiratory Services**	Date Originated: May 2013 Date Reviewed/Revised:
PROTOCOL	Topic: Critical Care – PAV+ (Proportional Assist Ventilation) with the 840 Ventilator (Respiratory Therapy) Number: B-00-12-12080	Related Links:

APPLICABLE SITES:

St. Paul's Hospital
Mount Saint Joseph Hospital

POLICY STATEMENT:

As this protocol is still in development, we request that you get a direct order from one of the staff physicians prior to initiating PAV+.

GENERAL INFORMATION:

Difficult and prolonged wean patients account for 20-25% and 5-15% respectively of all mechanically ventilated patients. The mortality is at least 25% [1] and while small in number they consume a disproportionately high percentage of ICU resources[2]. Studies and further meta-analyses have demonstrated that through the use of consistent weaning protocols morbidity and mortality can be reduced.[3]

DEFINITIONS:

Spontaneous Breathing Trial (SBT):
- A trial of spontaneous breathing done with minimal or no ventilatory support
- Helps determine whether a patient is appropriate for extubation

Simple Weaning:
- Successful completion of first SBT

Difficult Weaning:
- Failure of initial SBT
- Requires up to 3 SBT or up to 7 days from the first SBT to achieve successful weaning

Prolonged Weaning:
- Failed at least 3 SBT or greater than 7 days weaning from the first SBT

High Frequency Muscle Fatigue:

- Fatigue of skeletal muscle which occurs rapidly with intense contractile efforts but is usually not sever
- Often recovers rapidly with rest
- Indicates that the patient is exhausted and must be rested
- Signs of high frequency muscle fatigue are exit criteria

Low Frequency Muscle Fatigues:

- Fatigue of skeletal muscle that develops more slowly but is severe and requires hours or days for recovery
- Is consistent with the development of, and recovery from, muscle injury
- Can persist for days

Resting Ventilator Settings:

- Either a support or control mode that unloads ventilatory work of breathing from the patient to minimal level
- Either a high level of support ventilation or a control of ventilation

INDICATIONS:

Patients who have failed at least 3 consecutive SBT and have been ventilated at least 7 days after first meeting SBT criteria, and have a written order for PAV^+ will be considered for implementation of PAV^+ Weaning.

CAUTIONS:

PAV^+ is contraindicated in air leak syndromes - pressure support with an appropriate E-sensitivity (ensuring that the ventilator cycles to expiration) must be utilized.

PAV^+ may not trigger appropriately in a patient with high intrinsic PEEP and air trapping. Caution must be used to ensure that the patient is able to appropriately trigger the ventilator.

EQUIPMENT:

- 840 Ventilator

PROCEDURE:

PHASE I – PAV^+ Assessment:

1. Initiate PAV^+ at 80%. If the patient requires more than 80% support, return the patient to a controlled mode of ventilation and reattempt PAV^+ the next morning.

2. PAV^+ will be the primary mode for resting the patient. If PAV^+ is not tolerated or is contraindicated consider other supportive modes before proceeding to a controlled mode of ventilation for rest.

3. PAV^+ of 80% will be used as the resting PAV^+ level. Consider reducing the resting PAV^+ level only if the tidal volume is too high or the respiratory rate too low.

4. Place the patient on PAV^+ 35% for 30 minutes. If the PAV^+ trial is tolerated, extend the length of the trial until the patient reaches exit criteria. A PAV^+ of 35% will then become the trial PAV^+ level. The length of time to exhaustion (i.e. meeting exit criteria) will become the initial trial length.

5. If the patient meets exit criteria on a PAV^+ 35% within 30 minutes, rest the patient overnight and reattempt PAV^+ trial with a level 10% higher the next day.

   NOTE: The clinician may consider resting the patient for 3 hours and reattempt the PAV^+ trial with a level 10% higher on the same day if it appears appropriate. If the patient does not tolerate the second attempt wait until the next day and start at a PAV^+ trial an additional 10% higher.

6. Continue to increase the PAV^+ level in increments of up to 20% daily (10% x 2 attempts per day) until the patient is able to remain on the trial for a minimum of 30 minutes. The PAV^+ level required will then become the trial PAV^+ level. The length of time before reaching exit criteria will become the initial trial length.

PHASE II – PAV^+ Wean:

1. Reduce the PAV^+ support to the trial level as determined in Phase I. Initiate trials of increasing length followed by periods of rest according to Table 1. Monitor the patient for intolerance and exit criteria.

   Exit Criteria:

   - Respiratory rate greater than 40 sustained for 5 minutes
   - Heart rate increase greater than 20% from baseline or greater than 150 bpm
   - Blood pressure increase greater than 20% above baseline
   - New dysrhythmias
   - $EtCO_2$ increase greater than 15% above baseline

2. An accelerated wean may be considered if the f/Vt ratio remains less than 70-80 at the end of each trial. To accelerate wean, continue increasing the length of the trial until the patient meets the exit criteria or until the nightly rest period.

3. If the determined PAV^+ trial level is less than 60% upon completion of 16 hours, reinitiate Phase I PAV^+ Assessment at PAV^+ 35%. The patient will be placed on resting settings overnight and in between trials.

4. Document the results of each day's wean.

5. Patient must complete 16 hours of PAV^+ at less than 60% setting and successfully pass an SBT before moving to Phase III. If they do not pass, consider restarting assessment phase at PAV^+ 35%.

Table 1

Trial PAV+ Level	Length	Frequency	Total Trial Time	Rest Between Trails	Rest PAV+ Level	Rest Overnight
35%	30 min	4	2 hours	2 hours	80%	2200-0800
35%	1 hour	3	3 hours	2 hours	80%	2200-0800
35%	2 hours	2	4 hours	2 hours	80%	2200-0800
35%	3 hours	2	6 hours	2 hours	80%	2200-0800
35%	4 hours	2	8 hours	2 hours	80%	2200-0800
35%	8 hours	1	8 hours	N/A	80%	2200-0800
35%	12 hours	1	12 hours	N/A	80%	2200-0800
35%	16 hours	1	16 hours	N/A	80%	2200-0600

PHASE III – Corking, PMV, T-piece Wean:

1. Plug/cork the tracheostomy tube during Phase III trials to allow phonation and the use of vocal muscles and swallowing reflexes. Consider a PMV if corking is not tolerated.[9]

2. Use Optiflow trach adaptor if neither corking nor speaking valve are tolerated.

3. RT will place the patient on corking, PMV or t-piece trial for 30 minutes. If the patient tolerates the trial the RT will extend the patients trial until the patient reaches exit criteria. The length of time to exhaustion (meeting exit criteria) will become the initial trial length.

4. Return patient to rest setting on ventilator overnight.

5. Initiate trials according to Table 2 and begin at the initial trial length as determined by the previous day's trial.

6. Increase the length of corking, speaking valve or t-piece trials each day, and rest the patient in between as per Table 2.

7. Monitor for intolerance/exit criteria or accelerated wean pattern and adjust the weaning plan as necessary.

8. An accelerated wean may be considered if the RR remains less than 20 bpm at the end of each trial. To accelerate wean, continue increasing the length of the trial until the patient meets the exit criteria or until nightly rest period.

Table 2

Length	Frequency	Total Trial Time	Rest Between Trails	Rest PAV+	Rest Overnight

				Level	
30 min	4	2 hours	2 hours	80%	2200-0800
1 hour	3	3 hours	2 hours	80%	2200-0800
2 hours	2	4 hours	2 hours	80%	2200-0800
3 hours	2	6 hours	2 hours	80%	2200-0800
4 hours	2	8 hours	2 hours	80%	2200-0800
8 hours	1	8 hours	N/A	80%	2200-0800
12 hours	1	12 hours	N/A	80%	2200-0800
16 hours	1	16 hours	N/A	80%	2200-0600

REFERENCES:

1. Funk GC, Anders S, Breyer MK, Burghuber OC, Edelman G, Haindl W, Hinterholzer G, Kohansal R, Schuster R, Schwarzmaier-D'Assie A, Valentin A, and Hartl S. Incidence and outcome of weaning from mechanical ventilation according to new categories. Eur Respir J 2010; 35:88-94
2. Zilderberg MD, de Wit M, Pirone JR, and Shorr AF. Growth in adult prolonged acute mechanical ventilation: Implications for healthcare deliver. Crit Care Med 2008 36(5): 1451-1455
3. Bronagh B., Alderice F., Burns K., Cardwell C., Lavery G., O'Halloran P. Use of weaning protocols for reducing duration of mechanical ventilation in critically ill adult patients: Cochrane systematic review and meta-analysis. British Medical Journal 2011; 342:c7237
4. Boles JM., Bion J., Connors A., et al: Weaning from mechanical ventilation. Eur Respir J 2007; 29:1033-1056
5. Spitzer AR, Do TG, Maher L, Awerbuch G, and Bowles A. Neuromuscular causes of prolonged ventilator dependency. Muscle and Nerve 2004 15:682-686
6. Faulkner JA. Structural and functional adaptations of skeletal muscle.
7. Laghi F, Cattapan SE, Jubran A, Parthasarathy S, Warshawsky P, Choi YA and Tobin MJ. Is weaning Failure Caused by low-frequency fatigue of the Diaphragm? Am J Resp Crit Care Med 2003; 167:120-127
8. Heunks LM, van der Hoeven JG. Clinical review: The ABC of weaning failure- a structured approach. Critical Care 2010, 14:245
9. Bach JR, Alba AS. 1990 Tracheostomy Ventilation, a study of efficacy with deflated cuffs and cuffless tubes. Chest 97:679-683
10. Kacmarek RM. Proportional Assist Ventilation and Neurally Adjusted Ventilatory Assist. Respiratory Care 2011; 56(2):140-152
11. Bosma K, Ferreyra G, Ambrogio C, Pasero D, Mirabella L, Braghiroli A, et a.. Patient-ventilator interaction and sleep in mechanically ventilated patients: pressure support versus proportional assist ventilation. Crit Care Med 2007; 35(4): 1048-1054
12. Xirouchaki N, Kondili E, Vaporidi K, Xirouchakis G, Klimathianaki M, Gavriilidis G, et al. Proportional assist ventilation with load adjustable gain factors in critically ill patients:

comparison with pressure support. Intensive Care Med 2008; 34(11):2026-2034

13. Brochard L, Rauss A, Benito S, Conti G, Mancebo J, Rekik N, Gasparetto A, Lemaire F. Comparison of three methods of gradual withdrawal from ventilatory support during weaning from mechanical ventilation. Am J Resp Crit Care Med 1994; 150(4): 896-903
14. Vancouver Coastal Health. 2007. Weaning Pathway Guideline – ICU. RT-SER-173
15. Royal Columbian Hospital. 2011. Difficult to Wean Protocol – 2.3.4-101
16. Burnaby General Hospital. 2011. Pre-printed Orders Progressive Weaning Unit.