

Hospital of the University of Pennsylvania
Physician Practice Guideline

Number: 1-7-19

Page 1 of 5

SUBJECT: VENTILATOR LIBERATION AND WEANING PROTOCOLS FOR
THE MECHANICALLY VENTILATED PATIENT

Effective: 10/23/13

KEY WORDS:

Ventilator
Respirator
Weaning
Extubation
Liberation

PURPOSE:

To facilitate the liberation of patients from mechanical ventilation and provide a consistent approach to the ventilator weaning process. This pathway is a collaborative plan meant to guide the care of routine patients. It may be modified based on clinical indications, if appropriate and documented, or in emergency or unusual circumstances.

SCOPE:

This guideline applies to all patients at the Hospital of the University of Pennsylvania who meet the

ELIGIBILITY CRITERIA FOR VENTILATOR LIBERATION/WEANING PATHWAY as follows:

All patients placed on mechanical ventilation will be enrolled into this pathway except patients who are less than 18 years of age, pregnant, whose status is "Do Not Attempt Resuscitation- Level C" (DNAR-C), or patients who have, or are suspected of having an elevated intra-cranial pressure

IMPLEMENTATION:

This guideline will be implemented by physicians, auxiliary healthcare professionals acting within the scope of their privileges, nurses, and respiratory therapists responsible for the care of eligible patients as outlined below. Compliance with this guideline will be monitored by the director of respiratory care services, supervisory staff, and all other charge personnel.

PROCEDURE:

The ventilator liberation pathway will be implemented following the order of a physician or an auxiliary healthcare professional acting within the scope of his/her privileges. Eligibility for ventilator liberation or weaning protocols will be assessed daily through a **collaborative** evaluation between **respiratory therapy and nursing**. Prior to initiating the ventilator liberation protocol, the availability of all necessary personnel and equipment will be confirmed. The **physician** responsible will be consulted if there is any question about eligibility. The physician will be notified when a patient passes a spontaneous breathing trial (SBT) and is considered a candidate for extubation by **respiratory therapy**. Extubation will not be performed without a **physician order**. A Sunrise Clinical Manager (SCM) order is required if the physician wishes to bypass or override any steps in the pathway or if a reduction in the amount of ventilator support (i.e. via a partial support mode, Synchronized Intermittent Mandatory Ventilation (SIMV) or Pressure Support (PS)) is requested.

1. **FIO₂ Wean Protocol:** This protocol should be initiated for all patients following the initiation of mechanical ventilation, except for patients with a licox monitor, wherein the fraction of inspired oxygen (FiO₂) should not be weaned unless sanctioned by the Neurocritical Care Service
 - A. Use pulse oximetry (SpO₂) for FIO₂ weaning, providing it correlates with Arterial Blood Gas (ABG).
 - B. Within 30 minutes of intubation, if oxygen saturation is stable, wean FIO₂ by .1 to .2 every 15-30 minutes providing it is > 0.5 and SpO₂ is > 95% and/or partial pressure of arterial oxygen (PaO₂) is > 75 mmHg.
 - a. Goals: Hemoglobin oxygen saturation level (SpO₂) ≥ 94% for the following patient groups:
 - 1) Post-op
 - 2) Recent ischemia to heart or central nervous system (CNS)
 - 3) Sickle cell anemia
 - 4) Marked lability in saturation (SpO₂) (regularly drops > 4%)
 - b. SpO₂ ≥ 92% for all others
 - c. FiO₂ to ≤70
 - 1) Confirm adequacy of PaO₂ with an ABG when SpO₂ goal is reached
 - 2) If FiO₂ cannot be weaned to ≤70, discuss with the physician increasing the PEEP to accomplish this goal as soon as possible.

Hospital of the University of Pennsylvania
Physician Practice Guideline

Number: 1-7-19

Page 2 of 5

SUBJECT: VENTILATOR LIBERATION AND WEANING PROTOCOLS FOR
THE MECHANICALLY VENTILATED PATIENT

Effective: 10/23/13

2. **Daily Respiratory Eligibility Screen (RT): 3 Questions:** RT performs this daily screen on all ventilated patients on the Pathway between 5:00-7:00 am and prn on all post-operative, or post-procedure patients, when the patient begins to awaken from sedation (trigger ventilator). Must answer “yes” to first 3 questions/ “yes” to all 4 if patient has neuromuscular disease (NMD). Patients with NMD who pass , proceed to challenge-to-wean (CTW) protocol (III.8).

- A. Partial pressure of oxygen (PaO_2) ≥ 60 mmHg on $\text{FIO}_2 \leq 0.5$ with a PEEP of ≤ 7.5 & (SpO_2) $\geq 88\%$ (Accept PEEP up to 10cm H_2O for Surgical Critical Care Patients)
- B. Hemodynamically stable as defined by the absence of vasopressors, except for Dopamine/Dobutamine(Dopa/Dobut) of ≤ 5 mcg/kg/min or Norepinephrine(NE) ≤ 2 mcg/kg/min and no evidence of recent myocardial ischemic syndrome
- C. Patient is triggering the ventilator (If not \downarrow set minute ventilation (V_E) by 50% for up to 5 minutes, to detect breathing efforts, if $\text{pH} \geq 7.4^{**}$)
- D. NMD: Vital capacity (VC) >15 ml/kg, negative inspiratory force (NIF) >-25 , and maximum expiratory pressure (MEP) >40

****Note: Obtain an order from the physician or auxiliary healthcare professionals acting within the scope of their privileges to reduce V_E if recent increase in intracranial pressure (ICP).**

3. **SBT:**

A. Procedure:

- 1. Notify RN, and place patient in semi-fowlers position.
- 2. Put on Spontaneous Mode with PS of 7 for 30–120 minutes, on the same FIO_2 . Extend trial if ventilated for > 8 days or if patient is DNR-a or DNR-b. For subsequent trials use 120 minutes.
**Note: PS should be increased if endotracheal tube (\uparrow if ETT) $< \# 8$ (For size #7 use PS of 8-10)*
- 3. For very ill patients, discuss with the physician extending the trial by 30 minutes using a PS of 0-5 and no PEEP.
- 3. Monitor closely for “**tolerance**” (see definition below)
If SBT is not tolerated, immediately resume full ventilator support and retry every morning or q 4 hours on all post-op or post-procedure patients, for up to 4 days.

Definition of SBT tolerance:

a. No Symptoms of distress including:

- 1. Chest pain or SOB
- 2. Agitation, anxiety, diaphoresis

b. No Signs of distress including:

- 1. Respiratory rate (RR) > 35 for > 5 min
- 2. $\text{SpO}_2 < 90\%$ for 30 sec
- 3. Heart rate (HR) > 140 , or change of plus or minus 20% ($\Delta/\pm 20\%$) of baseline for > 5 min
- 4. Systolic Blood Pressure (SBP) > 180 or < 90 for > 5 min

B. Outcomes:

- 1. If SBT tolerated, perform extubation screen (ES) below.
- 2. If patient fails SBT on 4 consecutive days, patient will automatically be enrolled in CTW protocol (see III.8). However, unless the patient has a tracheostomy tube, continue to perform a daily morning SBT and record results. RT may also perform a daily SBT on trach patients, if they tolerate the trail.

4. **Extubation Screen (RT): 6 Questions:**

RT performs screen when patient passes SBT and everyday thereafter. Must answer “yes” to first 5

Hospital of the University of Pennsylvania
Physician Practice Guideline

Number: 1-7-19

Page 3 of 5

SUBJECT: VENTILATOR LIBERATION AND WEANING PROTOCOLS FOR
THE MECHANICALLY VENTILATED PATIENT

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questions/ “yes” to all 6 if NMD.

A. Is patient awake and responsive to verbal commands?

If “No”, enter code from unresponsiveness box on back of ventilator flow sheet or RASS (Richmond Agitation-Sedation Scale) score (obtain from RN)

B. Can Patient protect airway? Cough reflex intact and voluntary cough adequate to clear secretions?(refer to extubation screen criteria on back of ventilator flow sheet)

C. Cough strength :(1.Weak 2. Satisfactory 3.Strong)?

F. Suction Frequency (Q hr) is the patient suctioned every 1 hr, 2 hr, 3 hr etc. This is an estimate based on RT and RN’s documentation in the prior 6-8 hours

G. There are no concerns about the patency of the upper airway ? (If there are concerns, perform standard cuff leak test and document results) Note the leak volume

E. If NMD: Can patient sustain head lift maneuver against resistance?

- If patient passes, RT will notify physician and request an extubation and new O₂ order.
- If patient doesn’t pass, continue Spontaneous Mode /PS = 7 until ready for extubation.

Note: If excluded only because of #1, consider sedation interruption.

Note: If patient fails repeatedly, consider tracheostomy (and feeding tube) if intubated > 2 weeks.

5. **Extubation Procedure:** (Requires physician order):

A. It is the extubating physician’s responsibility to be aware of the “DIFFICULT TO INTUBATE PATIENT”. The presence of an anesthesiologist or senior critical care MD is required during the extubation for these patients. In addition, if prior airway trauma, injury, or history of difficult intubation, perform cuff leak test and consider fiberoptic inspection for airway patency prior to extubation.

B. Gastric feeds should have been held for 2 hours or more.

C. A mask for non-invasive ventilation (NIV) should be immediately available.

1. Notify RN

2. Suction patient through the oropharynx and ETT.

3. Instruct the patient to inspire maximally.

4. Extubate to Nasal Cannula (NC) at a flow of 4-6 l/min and observe closely for 20 – 30 minutes

5. Keep SpO₂ ≥ 92%; or ≥ 94% for the post-op patient or in the setting of recent ischemia to heart or CNS, or if sickle cell anemia.

a. If saturation drops below the above thresholds ↑ FIO₂ accordingly..

6. If signs or symptoms of respiratory failure ensue, manage expeditiously:

a. Stridor: Racemic Epinephrine (Racemic Epi.) at 0.5 every 20 minutes for up to three times as needed; humidified O₂, and consider dexamethasone

b. Respiratory rate (RR) > 35 or ↑ RR with other signs of distress: Try Non-Invasive Ventilation (NIV) before reintubating.

7. Cough and deep breathe every 1-2 hours

8. Nothing by mouth for 4 hours and then assess for aspiration risk.

9. If significant risk for aspiration, consult speech therapy before allowing oral intake and resume tube feeds when risk for reintubation appears minimal.

10. RT and RN assess patient every 4 hours and as necessary for signs of acute respiratory failure while in ICU.

6. **CTW PS Protocol will automatically be initiated for eligible patients (failed SBT on 4 consecutive days); an MD order is required for patients who have not failed 4 consecutive days of SBT trials**

- Wean between 8:00 am-8:00 pm.

A. **Verify eligibility criteria:**

1. See III.1 and 2: Medically stable, passes respiratory screen, and either:

Hospital of the University of Pennsylvania
Physician Practice Guideline

Number: 1-7-19

Page 4 of 5

SUBJECT: VENTILATOR LIBERATION AND WEANING PROTOCOLS FOR
THE MECHANICALLY VENTILATED PATIENT

Effective: 10/23/13

- a. Failed SBT for 4 days
- b. Repeated wean failure on another unit
- c. Primary neuromuscular disease (e.g. Gullian-Barre Syndrome (GBS), Myasthenia Gravis (MG))

B. Procedure:

1. Notify RN and optimize patient body position
2. Put on Spontaneous Mode and set PS at the lowest level that maintains comfort with a RR of 15-25 and a $V_T > 250$ ml (typically PS between 10-20), should not exceed 30.
Note: The physician may individualize rate and tidal volume parameters. If unable to maintain comfort with these or subsequent settings, consider alternate modes of weaning e.g. IMV or prolonged Spontaneous Mode trials. (If IMV used, \downarrow RR by 2 every 4 hours as tolerated until a RR of 4) Then proceed to Spontaneous Mode with PS of 7. Add 2 bpm at night for rest.
3. Decrease PS by 2-5 cm H₂O every 4 hours as tolerated and closely monitor, particularly during initial 10-20 minutes.
Note: This may be accelerated based on RT/RN judgment.
4. The level of PS should be increased immediately whenever a patient fails a weaning attempt. Resume wean after 6 hours or overnight if clinically indicated; e.g., respiratory failure.
5. At 8:00 pm, increase the PS by 5 cm for rest.
Note: The physician or auxiliary healthcare professionals acting within the scope of their privileges may choose rest mode and settings based on individual patient needs.
6. Next AM, resume PS at a level 2-5 cm less than previously tolerated daytime setting.
7. For planned exercise, or any other time when weaning cycle is interrupted, exit the protocol 1 hour before, and put on previous setting that was well tolerated. After exercise, resume protocol.
8. Continue weaning until PS ≤ 8 (ETT) or ≤ 3 (tracheostomy) for at least 12 hours (may be waived at physician's discretion).
9. Consider tracheostomy and Gastric tube or Jejunostomy tube (G or J) tube and transfer to chronic weaning facility if no significant weaning progress over 7-days.

C. Removal from assisted ventilation:

- Verify tolerance of Spontaneous Mode with PSV ≤ 7 cm (ETT) or ≤ 3 (with tracheostomy) for at least 12 hours (may be waived at the physician's discretion).
1. For intubated patient: Proceed with extubation screen the next morning (see III.6)
 2. For tracheostomy patient:
 - a. On Day 1- Put on a trach collar at 8:00 a.m. At 8:00 p.m., put back on PS at 10-12 cm for nocturnal rest. Reinflate cuff if deflated.
 - Consult speech therapy for Passy-Muir Valve (PMV) tracheostomy speaking valve and ability to handle oral secretions. Every day progressively extend the PMV trial as tolerated but not to exceed 12 hours (always use Trach Collar at night).
 - b. Day 2- at 8:00 am put on trach collar for 16 hours. At midnight, put back on PS at 10-12 cm. Reinflate cuff if deflated.
 - c. Day 3- at 8:00 am put on trach collar, for 24 hours
 - d. RT and RN assess patient in ICU every 4 hours and as needed for signs of respiratory failure.
Note: Ventilator remains on standby for 2 days
 - e. Once the PMV is tolerated for 12 hours consider downsizing tracheostomy tube to #6 Cuffed Shiley tube.
 - f. Begin capping trials and extend progressively as tolerated until able to tolerate for at least 24-48 hours.

Hospital of the University of Pennsylvania Physician Practice Guideline	Number: 1-7-19 Page 5 of 5
SUBJECT: VENTILATOR LIBERATION AND WEANING PROTOCOLS FOR THE MECHANICALLY VENTILATED PATIENT	Effective: 10/23/13

Note: Excessive secretions may be a contraindication to this procedure

- Keep SpO₂ ≥ 92% with supplemental O₂ (See III.7.5 for exceptions)
- g. If patient can tolerate trach capping for 48 hours with SpO₂ ≥ 90%, and able to clear secretions orally with minimal requirements for tracheal suctioning, they can be considered for decannulation. However, this decision is based on many other considerations including upper airway patency, cardiopulmonary reserve, anticipated upcoming procedures, amongst other considerations.

Note: Each of the above steps may be extended, based on the patient tolerance.

References

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SUPERSEDES: 9/27/10 ventilator Liberation and weaning protocols 2013	ISSUED BY: /s/ Michael Bleshman, MD
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