BOSTON MEDICAL CENTER
POLICY ON CREDENTIALING OF VENTILATOR MANAGEMENT

Purpose:
To delineate the Boston Medical Center (BMC) policy for credentialing of Ventilator Management.

Policy Statement:
This policy is designed to maintain safety in the care of patients while providing efficacy in the use of Mechanical Ventilators.

Application:
This policy applies to physicians who are not credentialed in Pulmonary Medicine. Residents, fellows, physician assistants, and nurse practitioners are not authorized to apply for Ventilator Management.

Exceptions:
- Critical Care Medicine and Cardiothoracic Surgery.

Credentialing procedure:

A. The request for Ventilator Management can be made as part of an initial application or recredentialing application or may be made by any member of the Medical-Dental staff at any time. Regardless of when they are obtained, Ventilator Management privileges expire simultaneously with a physician's current appointment period and privileges.

1. The attending phvsician seeking privileges in Ventilator Management:
   (a) Must contact the Medical Staff Office (YACC BN-C7, 8-6754) to obtain a copy of the Ventilator Management PowerPoint presentation (Attachment A) and become familiar with it.
   (b) Must complete the *Mechanical Ventilation Credentialing Exam* (Attachment B) and return it to the Medical Staff Office. 75% of the questions must be answered correctly.

2. The Medical Staff Office:
   (a) Will review the submitted test, and assign a score to each based on the number of questions answered properly.

3. Requests with passing scores:
   (a) Will be compiled by the Medical Staff Office, and submitted, along with the scored test, to the Section/Department Chief if applicable or directly to Division Chief. The request will then proceed according to the procedures described in the Medical Dental Staff Bylaws.

4. Requests with non-passing scores:
   (a) Will be compiled by the Medical Staff Office, and submitted, along with the scored test and a clearance form, to the the Medical Director of Respiratory Therapy or a designee.
   (b) Will be reviewed by the the Medical Director of Respiratory Therapy who will be responsible for any education and remediation deemed necessary.
   (c) Will be returned to the Medical Staff Office, along with a clearance form, which will indicate the the Medical Director of Respiratory Therapy 's recommendation for the granting or denying of the request, and any reasons set forth.
   (d) Will be submitted by the Medical Staff Office, along with the completed clearance form, to the Section/Department Chief if applicable or directly to Division Chief. The request will then proceed according to the procedures described in the Medical Dental Staff Bylaws.

Quality Assessment:
Each Division/Department should participate in regular QA activities. The Joint Commission has sample size recommendations which can be found in the Comprehensive Accreditation Manual for Hospitals (CAMH).

ATTACHMENT A

Mechanical Ventilation Cardiology.ppt

Indications for Intubation

- Airway control in patient who cannot protect their own airway
- Upper Airway Obstruction
- Selected Procedures where airway control is desired
- Requirement for Mechanical Ventilation

Terminology of Endotracheal Tubes

- Size of tube refers to internal diameter
- Cuffs are high volume and low pressure
- Cuffs are inflated to MOP
  - Protect against aspiration of objects
  - Little protection against liquid aspiration
  - No protection against feeding tubes

Endotracheal Tube Placement

- Daily confirmation
  - Radiologic
    - 2 cm above carina
    - below the clavicle
  - Bedside
  - Endoscopic

Indications for Mechanical Ventilation

- Hypoxemia
- Hypercarbia
- Acidosis

Respiratory Failure

- Failure to oxygenate
  - V/Q mismatch
  - Shunt
- Failure to ventilate
  - Increased CO2 production
  - Decreased capacity of CO2 removal (i.e.,loss of avleolar capillary surface area
  - Increased metabolic acid production
  - Increased dead space
- Both

Sequella of Mechanical Ventilation

- Improve v/q matching
  - Improves oxygenation
  - Decreases dead space
- Assists/replaces respiratory muscles
  - Decrease production of CO2 from Respiratory Muscles
  - Prevents atelectasis from low tidal volumes

Ventilation Modes

- Volume
  - SIMV
  - AC, VC
  - PRVC
- Pressure
  - PC
  - PS

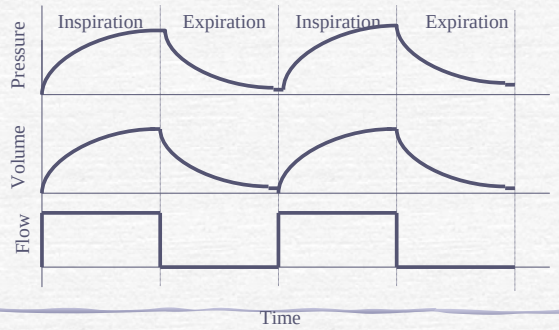
SIMV

- Initial mode and weaning mode
- Variables are rate, TV, FiO2, PEEP, PS, Flow rate
- Fully assisted breaths timed with patient's efforts
- Spontaneous breaths are unassisted unless PS is added
- Most comfortable for an awake patient

Assist Control, Volume Control

- Initial mode
- Variables are rate, TV, FiO2, PEEP, Flow rate
- Useful for patients with high $\dot{V}_E$ demand
  - Acidosis
  - Sepsis
- Use with caution in neurologic patients
- Spontaneous breaths above set rate receive full TV

Volume Ventilation



Pressure Regulated Volume Control

- Secondary Mode
- Variables are rate, TV, FiO2, PEEP, Flow rate
- Ventilator calculates compliance and delivers set volume by cycling as pressure ventilator
- Spontaneous breaths above set rate receive full TV
- Useful when PIPs high and oxygenation adequate

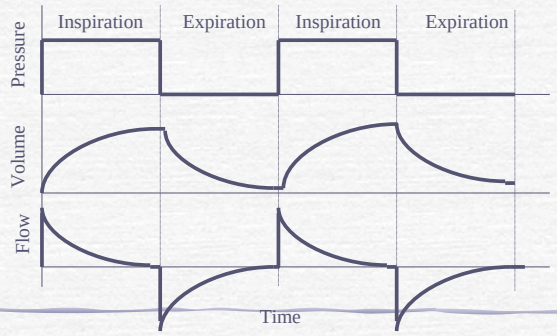
PRVC 2

- Advantages
  - Allows delivery of set tidal volume
  - Does not require paralysis
- Disadvantages
  - Uncomfortable
  - Not as effective as PCV in matching V/Q

Pressure Control

- Secondary mode
- Variables are rate, Pressure, FiO2, PEEP, I:E time
- Conversion allows ventilation with less PIP
- Improves V/Q matching by recruiting marginal alveoli
- Indications
  - High PIPs
  - Poor oxygenation

Pressure Control Ventilation



Pressure Control Ventilation

- Advantages
  - Delivers via square wave
  - Lowers PIP
  - Improves V/Q
    - Improves Oxygenation
    - Lowers dead space
- Disadvantages
  - Generally requires paralysis
  - Uncomfortable
  - $\dot{V}_E$ can vary greatly if acute restriction/obstruction develop

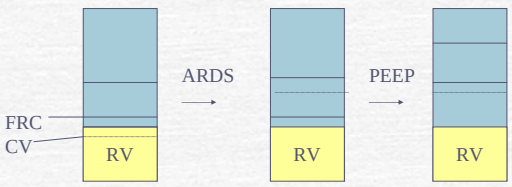
Pressure Support

- Weaning mode
- Variable is pressure (set above PEEP)
- Assists inspiration effort
- Lowers work of breathing and overcomes resistance of endotracheal tube

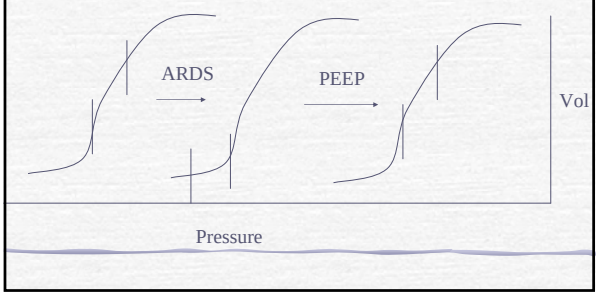
PEEP

- Physiologic Action
  - Increases FRC
  - Changes lung compliance
  - Changes V/Q
- Consequences
  - Increases in oxygenation
  - Increase in intrathoracic pressure
  - Decrease in venous return
  - Compression of RV

PEEP



PEEP



Inverse Ratio Ventilation

- Indications
  - Compliance poor
  - Inability to oxygenate
- Contra-indications
  - Obstructive airways disease
  - Low filling pressures
  - Severe RV dysfunction

Inverse Ratio Ventilation 2

- Effects
  - Allows time for marginal alveoli to open
  - Improves V/Q matching
    - Improved oxygenation
    - Improved ventilation
  - Increases mean intrathoracic pressure
    - Decrease venous return
    - Compresses RV
    - Decreases RV (and LV) filling time

CPAP

- Useful in Pulmonary Edema/CHF
- Mechanically similar to PEEP
- Used in spontaneous breathing mode
- Recruits marginal alveoli
- Increases intrathoracic pressure
- Oxygen percent limited

BIPAP

- Useful in hypercapnic respiratory failure
- Mechanically similar to PEEP and PS
- Increases intrathoracic pressure
- Recruits marginal alveoli
- Lowers work of breathing
- Oxygen percent limited

Initial Ventilator Management 1

- Choose ventilator mode
  - Volume ventilator
    - SIMV
    - AC
      - Acidosis
      - High CO_2 production

Initial Ventilator Management 2

- Choose settings
  - Tidal Volume (6-10 cc/kg)
  - Minute Volume (3-20 L/m)
  - PEEP 5 cm
  - Fi02 .95
  - I:E 1:2
- Add PS so sVt > 5 cc/kg

PIP Components

- Total PIP = Resistance + Compliance
  - Resistance = Measurement of Obstruction
  - Compliance = Measurement of Stiffness
- Normal PIP = 25 cm H2O
  - Normal resistance = 5 cm
  - Normal compliance = 20 cm

Abnormal PIPS

- Low-leak in system
  - Cuff leaks
  - Disconnected tubing
  - Ventilator malfunction
- High
  - Increase in airways resistance
  - Decrease in lung compliance

Maneuvers to Determine Causes of High PIP

- Inspiratory Pause
  - Measurement of Static compliance
  - Total PIP – Compliance = Resistance
  - Patient can be over breathing vent rate
- Expiratory Pause
  - Measurement of Auto PeeP)
  - Requires no spontaneous breathing

Causes of High PIPs

- Obstructive
  - Reversible- fluid, secretions, bronchospasm, inflammation
  - Irreversible-emphysema
- Restrictive-
  - Stiff lungs from fluid/infection
  - Lung compression
    - Pleural effusion
    - Pneumothorax
    - Atelectasis
    - Mainstem intubation
- Both

Auto PEEP

- Measures hyperinflation and air trapping
- Contributes to total PIP
- Causes hypoxemia through V/Q mismatch
- Cause of agitation/discomfort

Strategies for the Treatment of Increased Resistance

- Decrease ventilator rate
- Increase I:E ratio
- Decrease tidal volume
- Increase PEEP
- Change to PRVC/PC mode
- Paralysis

Failure of SIMV/AC Ventilation

- PIPs over 40 cm H20
- Inability to oxygenate
  - Requirement for fiO2 >0.6-0.7
  - Requirement for PEEP $\geq$ 10 cm H2O
- Inability to ventilate
  - Respiratory acidosis with pH <7.3
  - Ve > 15 L/m in the presence of airways obstruction

Sudden Decompensations

- When in doubt BAG IT

Strategies for Treating Low Compliance

- Lower tidal volumes
- Change to PRVC/PC
- Increase PEEP
- IRV
- Paralysis

Weaning Requirements

- Adequate mechanics
- Oxygenation on FiO2≤ 40 %
- Absence of active infection
- Mental status awake
- Normal electrolytes
- Absence of secretions
- Adequate oxygen delivery
  - Hemoglobin
  - Cardiac output
- Absence of ischemia
- Optimal Volume status

Respiratory Mechanics

- Vt > 5 cc/kg IBW
- VC > 10 cc/kg IBW
- VE 6-10 l/m
- NIF < -25 cm H2O
- RSBI < 100 (RR/Vt (L))

Weaning Protocols

- Optimize requirements
- Check mechanics
- PS trial for 15 min – 2 hours
- Re-assess
  - ABG (pCO2)
  - Mechanics
- Confirm cuff leak

Case Presentation

85 year old female (60 kg IBW) with COPD from Norwood admitted to the BMC CCU with chest pain and infero-lateral ST elevation following a recent AAA repair becomes hypoxemic and hypotensive. She is intubated and sedated and placed on a ventilator with settings of:

Mode	SIMV
TV	450 cc
Rate	12
PEEP	5 cm
FiO2	0.95
I:E.	1:2

Case Presentation 2

She is taken to the catheterization lab and is found to have a left dominant system. She undergoes an angioplasty to the left circumflex artery and returns to the CCU. On arrival she is agitated with a RR of 32. The ventilator high pressure alarm keeps popping. The nurses note oxygen desaturation to 80 % on the FiO2 of 0.95. It is difficult to hear any breath sounds. The admitting resident, Dr. Hopeless, paralyzes the patient, and obtains:

an ABG:	7.20/50/50
a Chest film:	hyper-inflated and hazy, with a streaky R perihilar infiltrate extending to the base

Case Presentation 3

After looking at the ABG and chest film Dr. Hopeless calls you.

What do you want to know?

PIP:	43 cm H2O
Plateau Pressure:	28 cm H2O
AutoPEEP:	12 cm H2O

Case Presentation 4

Bronchodilators and diuretics are ordered

What adjustments do you make on the vent?:

Increase/no change/decrease rate	Decrease
Increase/no change/decrease TV	Increase
Increase/no change/decrease PEEP	No change
Increase/no change/decrease I:E	Increase

Case Presentation 5

After the vent settings ABG are: 7.35/48/75

Two days later the intern, Dr. useless, is called to the beside when the high pressure alarm pops off and the patient desaturates. Breath sounds are difficult to hear.

ABG: 7.28/65/48
CxR: Hyperinflation, Focal RLL infiltrate, bilateral effusions, diffuse interstitial markings

Case Presentation 6

Vent settings are:

TV 500
Rate 10
PEEP 10
I:E 1:2
FiO2 .8

What do you want to know ?

PIP:	45
Plateau	38
AutoPeep	2

Case Presentation 7

You make the following changes:

Mode	PRVC/PVC
Volume/pressure	450/28
Rate	10
PEEP	10
FiO2	.8

Case Presentation 8

Following the change ABG are: 7.35/52/65

The next day the patient becomes hypotensive and suffers a PEA arrest from which she could not be resuscitated.

ATTACHMENT B
Boston Medical Center
Mechanical Ventilation Credentialing Exam March, 2004

1. The size of an Endotracheal Tube refers to the internal diameter of the tube.

True False

2. Confirmation of proper endotracheal tube placement should be performed daily.

True False

3. Adjusting the ventilator settings (except oxygen percent) on the ventilator should only be performed by a respiratory therapist.

True False

4. Ventilator orders must be (re)written daily.

True False

5. Deflating the endotracheal tube balloon and finding an air leak is mandatory before proceeding with extubation.

True False

6. 85 year old female (60 kg IBW) with COPD from Norwood admitted with chest pain and infero-lateral ST elevation following a recent AAA repair becomes tachypneic, hypoxemic and hypotensive. She is intubated and sedated and placed on a ventilator. Appropriate initial ventilator settings are:

	Mode	TV	Rate	PEEP	FiO2
A.	SIMV	300 cc	12	5.0	0.95
B.	SIMV	500 cc	12	5.0	0.95
C.	SIMV	500 cc	18	0	0.95
D.	AC	500 cc	18	5.0	0.40
E.	AC	900 cc	12	5.0	0.95

7. Autopeep is measured by:

A. Performing an inspiratory pause
B. Performing as expiratory pause
C. Decreasing the set PEEP to 0
D. Administering paralytics
E. Turning the respiratory rate to zero

8. A PIP of 45 cm and a plateau of 30 cm indicates:

A. Decreased lung compliance
B. Increased airway resistance
C. Increased airway conductance
D. Both A and B
E. Both A and C

9. An 85 year old diabetic male weighing 80 kg with ESRD on HD is admitted with pulmonary edema. He is paralyzed, intubated and placed on mechanical ventilation in the Emergency Department. On exam he is very wheezy. The PIPS are 42 on vent settings of SIMV, TV 600 and rate 16 . An autopeep is measured at 17 cm above PEEP. An ABG is 7.25/55/65/95%. The proper ventilator maneuver is to:

A. Decrease respiratory rate
B. Increase respiratory rate
C. Increase FiO2
D. Increase Tidal volume
E. Begin Inverse Ratio Ventilation

10. A 47 year old male with three vessel Coronary Disease is admitted to the CCU and undergoes a CABG. While in the recovery room he develops oxygen desaturation and bilateral lung haziness on chest x-ray. On vent settings of SIMV 12, TV 600, PEEP 5.0 and FiO2 of 100 % his PIPs are 40 cm with a plateau of 35 cm and his arterial blood gasses are 7.30/50/58/90%. An appropriate ventilator maneuver would be to:

A. Change to a PC mode with a set TV of 600 cc
B. Increase PEEP to 10 cm
C. Change to a PRVC mode with a set TV of 600 cc
D. Change to an AC mode with a set TV of 600 cc
E. Change to a PC mode with a TV of 800 cc

11. Assist control ventilation is useful in patients with:

A. High minute ventilation requirements from acidosis and/or sepsis
B. Severe airways obstruction and tachypnea
C. Severely decreased lung compliance
D. Hyperventilation syndromes
E. Barotrauma

12. Characteristics of PRVC ventilation include

A. More comfort for the patient
B. Best mode for V/Q matching
C. Delivery of a set volume
D. Requirement for paralysis
E. Assisted breaths over set rate are not supported

13. A sudden increase in PIP may be related to:

A. Pneumothorax
B. Mainstem intubation
C. Atelectasis
D. All of the above
E. None of the above

14. Successful weaning from a ventilator is predicted by:

A. Minute ventilation < 6 L/m
B. RSBI > 100
C. Minute ventilation > 10L/m
D. RSBI < 100
E. Vt < 5 cc/kg

15. Routine weaning times (spontaneous breathing trials) should be from:

A. 5 minutes to 15 min
B. 15 minutes to 2 hours
C. 5 minutes to 4 hours
D. 2 hours to 4 hours
E. 4 hours to 8 hours

16. A 72 year old 70 kg male is admitted with congestive heart failure from the ED and arrives on mechanical ventilation with settings of mode = SIMV, f = 10, FiO2 of 0.4, Vt of 550 cc, Peep of 5 cm and PS of 5. He is breathing at a rate of 36 and appears uncomfortable with oxygen saturations of 95%. His PIPs are 30 and spontaneous tidal volumes are 150 cc. A ventilator intervention would be to:

A. Increase FiO2 to 0.95
B. Increase PEEP to 7.5
C. Change mode to PRVC
D. Change mode to PC
E. Increase PS to obtain sVt > 5 cc/kg

17. All of the following are indications to change from SIMV/AC to PRVC/PC **EXCEPT:**

A. PIPs over 40 cm H20
B. Requirement for fiO2 >0.6 - 0.7
C. Requirement for PEEP $\geq$ 10 cm H2O
D. Metabolic acidosis with pH < 7.3
E. V_E > 15 L/m in the presence of airways obstruction

18. Inverse ratio ventilation

A. Should be considered in patients with airways obstruction
B. Should be considered in patients with neurologic disease
C. Increases venous return to the right ventricle
D. Decreases the danger of autopeep
E. Increases inspiratory time percent

19. An 80 year old female enters the CCU with respiratory failure requiring mechanical ventilation after sustaining a large anterior MI complicated by aspiration and congestive heart failure. After 4 days she is doing well and is about to undergo a weaning trial but suddenly develops acute respiratory distress with high pressure alarming, hypotension and oxygen desaturation. Proper ventilator mangement includes:

A. Increasing the ventilator rate
B. Increasing the Peep
C. Increasing the tidal volume
D. Removing the ventilator and beginning ambu ventilation
E. Changing the ventilator mode

20. Physiologic actions of PEEP include:

1. Decrease in FRC
2. Increase in FRC
3. Recruitment of marginal alveoli
4. Increase in surfactant

A. 1 and 3
B. 2 and 4
C. 2 and 3
D. 1 and 4
E. 3 and 4