Mechanical Ventilation; Adult (Optional)

History
- Multiple etiologies leading to need for advanced airway control
- Requires ventilation support
- Height and underlying lung conditions

Signs and Symptoms
- Loss of consciousness or AMS with inability to protect airway
- Difficult oxygenation and/or ventilation
-

Differential
- ROSC
- Trauma
- Stroke
- Seizure
- Shock (see Shock Protocol)
- Toxicological

Age Appropriate Airway Protocol(s) AR 1, 2, 3, 5, 6 ***if indicated***

Post-intubation/BIAD Management Protocol AR 8 ***if indicated***

History of COPD or Asthma?

NO

MODE: Volume – Assist Control

FiO_2: 100%

PEEP: 5 cmH_2O

TIDAL VOLUME (V_t): 8 mL/kg
Follow PBW and V_t on page 3

BPM: RESPIRATORY RATE: 18 BPM

FLOW RATE: 60 mL/min *(preset)*

Check Plateau Pressure
Press Manual Breath
P Pressure button
Goal Pressure < 30 cm/H_2O

Decrease Tidal Volume
1 mL/kg increments
Until ≤ 29 **cm/H_2O**
(DO NOT DECREASE < 4 mL/kg)

P

After 10 minutes
Decrease FiO_2 down to 50%
Then adjust PEEP and FiO_2
Goal SpO2 92 – 98%

Step 1: **PEEP =10 FiO_2 =50%**

Step 2: **PEEP =10 FiO_2 =60%**

Step 3: **PEEP =10 FiO_2 =70%**

Step 4: **PEEP =12 FiO_2 =70%**

Step 5: **PEEP =14 FiO_2 =70%**

P

Alarming Ventilator and unsure how to troubleshoot

- Immediately disconnect patient and use BVM.
- Once oxygenation and ventilation stabilized, restart ventilator set-up procedure.

Home Ventilator
Inter-facility Transfer with Ventilator

- Set initial parameters to home or facility settings
- Titrate to oxygenation, work of breathing, SpO_2, and $EtCO_2$.
- Use home ventilator if functioning properly.

YES

MODE: Volume – Assist Control

FiO_2: 100%

PEEP: 5 cmH_2O

TIDAL VOLUME: 8 mL/kg
Follow PBW and V_t on page 3

BPM: RESPIRATORY RATE: 12 BPM

FLOW RATE: 60 mL/min *(preset)*

I:E Ratio
Increase to 1:4 or 1:5

Check Plateau Pressure
Press Manual Breath
P Pressure button
Goal Pressure < 30 cm/H_2O

Decrease Tidal Volume
1 mL/kg increments
Until ≤ 29 **cm/H_2O**
(DO NOT DECREASE < 4 mL/kg)

P

Check Peak Inspiratory Pressure (PIP)
Goal V_t is 8 mL/kg

ADJUST PIP Alarm Settings
- Up until full exhalation achieved on 8 mL/kg Tidal Volume

P

Notify Destination or Contact Medical Control

Universal Protocol Section

Mechanical Ventilation; Adult (Optional)

Universal Protocol Section

Pearls

- **Recommended Exam: Mental Status, Skin, HEENT, Heart, Lungs, Abdomen, Back, Extremities, Neuro**
- **Mechanical ventilation may be used in any patient ≥ 1 year old.**
- **MODE:**
  - **In all adult patients use Volume – Assist Control.**
  - **This mode requires adequate sedation as it can be uncomfortable in a patient who is awakening.**
- **TIDAL VOLUME:**
  - **Tidal volume is very important in preventing lung injury and calculated by height and predicted body weight, or ideal body weight, and NOT actual body weight.**
  - **Follow Tidal Volume by Height Table on page 3.**
  - **Follow Tidal Volume by Height Table on page 3 when adjusting Peak Inspiratory Pressure alarms to allow full exhalation.**
  - **High Tidal Volumes are well known to cause alveolar damage and lung injury.**
- **FLOW RATE:**
  - **A normal breath (non-mechanical ventilation) has highest flow and volume at the beginning and both decrease as inspiration comes to an end.**
  - **Setting Flow Rate at 60 L/minute allows patient to take full breath without air hunger toward end of inspiration. This is more comfortable for the patient.**
  - **If patient looks like they are trying to take in more volume initially, the Flow Rate can be increased by increments of 5 as needed to improve patient comfort.**
- **FiO_2 and PEEP Adjustments:**
  - **Seems intuitive that when SpO_2 is less than desired the FiO_2 should be increased.**
  - **When FiO_2 is ≥ 50% and SpO_2 remains low, this indicates a shunt, and PEEP must be used in conjunction with FiO_2 to correct the shunt and increase oxygenation.**
  - **Follow PEEP adjustment recommendations on page 1.**
- **$EtCO_2$:**
  - **EtCO_2 and arterial CO_2 do not always correlate well in patients with lung disease or during serious illness or injury.**
  - **Use caution in adjusting respiratory rate to reach a goal of 35 – 45 mmHg. Most intubated patients do not need tight control in this range.**
  - **Patients with suspected head injury do need EtCO2 with a target of 35 – 45 mmHg.**
  - **Allowing patients with COPD and asthma exacerbations to have higher EtCO2 outside the 35 – 45 mmHg range is acceptable. Lower ventilation rates allow more time for exhalation and prevents auto-PEEP and/ or air trapping.**
- **DOPE: D**isplaced tracheostomy tube / ETT, **O**bstructed tracheostomy tube / ETT, **P**neumothorax and **E**quipment failure.

Mechanical Ventilation; Adult (Optional)

TIDAL VOLUME INITIAL SETTINGS By HEIGHT

FEMALE
Height / Predicted body weight / Vt

HEIGHT	PBW	4 ml	5 ml	6 ml	7 ml	8 ml
4' 0" (48)	17.9	72	90	107	125	143
4' 1" (49)	20.2	81	101	121	141	162
4' 2" (50)	22.5	90	113	135	158	180
4' 3" (51)	24.8	99	124	149	174	198
4' 4" (52)	27.1	108	136	163	190	217
4' 5" (53)	29.4	118	147	176	206	235
4' 6" (54)	31.7	127	159	190	222	254
4' 7" (55)	34	136	170	204	238	272
4' 8" (56)	36.3	145	182	218	254	290
4' 9" (57)	38.6	154	193	232	270	309
4' 10" (58)	40.9	164	205	245	286	327
4' 11" (59)	43.2	173	216	259	302	346
5' 0" (60)	45.5	182	228	273	319	364
5' 1" (61)	47.8	191	239	287	335	382
5' 2" (62)	50.1	200	251	301	351	401
5' 3" (63)	52.4	210	262	314	367	419
5' 4" (64)	54.7	219	274	328	383	438
5' 5" (65)	57	228	285	342	399	456
5' 6" (66)	59.3	237	297	356	415	474
5' 7" (67)	61.6	246	308	370	431	493
5' 8" (68)	63.9	256	320	383	447	511
5' 9" (69)	66.2	265	331	397	463	530
5' 10" (70)	68.5	274	343	411	480	548
5' 11" (71)	70.8	283	354	425	496	566
6' 0" (72)	73.1	292	366	439	512	585
6' 1" (73)	75.4	302	377	452	528	603
6' 2" (74)	77.7	311	389	466	544	622
6' 3" (75)	80	320	400	480	560	640
6' 4" (76)	82.3	329	412	494	576	658
6' 5" (77)	84.6	338	423	508	592	677
6' 6" (78)	86.9	348	435	521	608	695
6' 7" (79)	89.2	357	446	535	624	714
6' 8" (80)	91.5	366	458	549	641	732
6' 9" (81)	93.8	375	469	563	657	750
6' 10" (82)	96.1	384	481	577	673	769
6' 11" (83)	98.4	394	492	590	689	787
7' 0" (84)	100.7	403	504	604	705	806

MALE
Height / Predicted body weight / Vt

HEIGHT	PBW	4 ml	5 ml	6 ml	7 ml	8 ml
4' 0" (48)	22.4	90	112	134	157	179
4' 1" (49)	24.7	99	124	148	173	198
4' 2" (50)	27	108	135	162	189	216
4' 3" (51)	29.3	117	147	176	205	234
4' 4" (52)	31.6	126	158	190	221	253
4' 5" (53)	33.9	136	170	203	237	271
4' 6" (54)	36.2	145	181	217	253	290
4' 7" (55)	38.5	154	193	231	270	308
4' 8" (56)	40.8	163	204	245	286	326
4' 9" (57)	43.1	172	216	259	302	345
4' 10" (58)	45.4	182	227	272	318	363
4' 11" (59)	47.7	191	239	286	334	382
5' 0" (60)	50	200	250	300	350	400
5' 1" (61)	52.3	209	262	314	366	418
5' 2" (62)	54.6	218	273	328	382	437
5' 3" (63)	56.9	228	285	341	398	455
5' 4" (64)	59.2	237	296	355	414	474
5' 5" (65)	61.5	246	308	369	431	492
5' 6" (66)	63.8	255	319	383	447	510
5' 7" (67)	66.1	264	331	397	463	529
5' 8" (68)	68.4	274	342	410	479	547
5' 9" (69)	70.7	283	354	424	495	566
5' 10" (70)	73	292	365	438	511	584
5' 11" (71)	75.3	301	377	452	527	602
6' 0" (72)	77.6	310	388	466	543	621
6' 1" (73)	79.9	320	400	479	559	639
6' 2" (74)	82.2	329	411	493	575	658
6' 3" (75)	84.5	338	423	507	592	676
6' 4" (76)	86.8	347	434	521	608	694
6' 5" (77)	89.1	356	446	535	624	713
6' 6" (78)	91.4	366	457	548	640	731
6' 7" (79)	93.7	375	469	562	656	750
6' 8" (80)	96	384	480	576	672	768
6' 9" (81)	98.3	393	492	590	688	786
6' 10" (82)	100.6	402	503	604	704	805
6' 11" (83)	102.9	412	515	617	720	823
7' 0" (84)	105.2	421	526	631	736	842

TROUBLESHOOTING Hypoxia or Deterioration DOPES	
D	Dislodged ETT or cuff leak
O	Obstruction of ETT or circuit
P	Pneumothorax, Pneumonia, Pulmonary embolism or edema, Plug (mucous)
E	Equipment problem
S	Stacked breaths, air trapping, or auto-PEEP

RESPONSE to Hypoxia or Deterioration DOTT	
D	Disconnect ventilator, squeeze chest if auto-PEEP, Decompress if pneumothorax
O	Oxygen 100% FiO2, BVM and check compliance
T	Tube position and function, check EtCO2
T	Tweak ventilator settings or equipment

Pressure Alarm Troubleshooting			Problem Location	Consider
High PIP	+	High Plateau > 30	Alveoli	Compliance problem: Pneumothorax, Pneumonia Pulmonary Edema or Embolism, CHF
High PIP	+	Normal Plateau < 30	Airway problem	Airway, ventilator, or circuit problem: DOPE, Right Main stem intubation, Air trapping or auto-PEEP, Mucous plug, Patient out of synchrony with ventilator

Universal Protocol Section