CENTRAL OTAGO HEALTH SERVICES LIMITED

Ventilation Guideline Dunstan – Medical

The ventilator: Oxylog 3000 plus. (*for oxylog details see Ventilator resource book*).

To start ventilator:

1) Plug into wall oxygen + check tubing attached
2) Turn on
3) Select tubing with rotatory knob: (either (i) adult disposable or (ii) paediatric).

To ventilate: Ensure Patient apneic from sedation and nursed at 30 degrees.

1) **Mode:** Defaults to VC-SIMV. (volume control- synchronised intermittent mandatory ventilation). Reasonable to start with this. Mode could be changed in consultation with ICU.
2) **Settings:** Choose based on table below.
   -Tidal volume, RR and FiO2 are set using knobs below screen.
   -PEEP and I:E ratio are selected on the screen using the rotatory knob.

Table 1: The following table is a quick guide to ventilator settings for most patients.

Clinical situation	**Tidal volume** (Vt) (ml/Kg IBW*)	**RR** *(adjust based on pCO2)*	**FiO2** (1.0 = 100%) *Use 1.0 while put on vent. (then titrate to O2sats).*	**PEEP** (cmH2O/ mbar) *(adjust to O2sats)*	**I:E ratio**
Normal lung Mechanics. Eg Overdose, HI, Coma…	**6-8** (6-8)	**12**	Start at 0.4 and titrate. *Aim O2sats 92-95%.*	**5**	1:2
Airflow Obstruction Eg Asthma, COPD (obstructive strategy)	**6-8** (4-8)	**8** (6-10)	Start at 0.4 and titrate. *Aim O2sats 88-95%.*	**0** For asthma. **0-5** For COPD.	≥ 1:4
Acute hypoxaemia Eg Pneumonia, ARDS (lung protective strategy)	**6-8** (4-8) Reduce if Pplat >30.	**18** (16-35)	ARDS PEEP-FiO2 chart: (Lower PEEP/higher FiO2) FiO2: 0.4 0.5 0.6 0.7 0.8 0.9 1.0 PEEP: 5–8 8–10 10 10–14 14 14–18 18–24 *Aim for O2sats 88-95% (or PaO2 55-80)*		1:1.5

*IBW (ideal body wt): Female = 45.5 + (0.91 x (Ht in cm -152.4)). Male = 50 + (0.91 x (Ht in cm -152.4)).

	5'0'' 153cm	5'2'' 158cm	5'4'' 163cm	5'6'' 168cm	5'8'' 173cm	5'10'' 178cm	6' 183cm	6'2'' 188cm	6'4'' 193cm
Vt Female (6ml/kg IBW)	276	295	330	360	385	415	440	470	490
Vt Male (6ml/kg IBW)	305	320	360	385	415	440	470	490	520

*Pmax (alarm) setting: set at ~35cmH2O as default.
If it alarms (see "trouble shooting" PTO) check: Patient (agitation), Chest & Lungs(BS, AE), Tube obstruction.
If no reversible cause found: check Plateau pressure (Pplat). If >30 reduce Vt by 1ml/kg steps (Do not go lower than 4ml/kg).

Specific situations:

Head Injury: 30 degrees head up. Aim for low-normal pCO2. Avoid too much peep (aim ~5) or lowers CPP.
Metabolic acidosis: Aim for ETCO2 < patient achieved (RR > patient's). Give PS for spontaneous breaths.
Cardiogenic APO with high BP: Use higher peep. Start PEEP at 10 and titrate up.
Shock: Avoid high levels of PEEP as can reduce BP. If PEEP drops BP, also given fluids/uppers. (aim MAP >65).
Pregnancy: Left lateral position. Vt 8ml/kg IBW. RR 18-20. Aim for low-normal CO2 and normal pH.

Trouble Shooting –the Ventilator

Crashing patient/Haemodynamic instability: DOPES
(Displaced or Obstructed tube, Pneumothorax, Equipment failure, Stacking breaths).

High Airway Pressure:

-PIP = Peak inspiratory pressure (what Pmax alarm is set to). -Pplat = Plateau pressure (approx. alveolar p.)
-NOTE: Peak Airway Pressure (PIP) = Alveolar pressure (Pplat) + Pressure from Resistance to flow in airways.
*Excessive alveolar pressure (not nec PIP) may damage lungs, cause air leak, have haemodynamic effects.

Causes of High airway Pressure:

(i) High Airway Resistance to flow
(=High PIP, normal Pplat):
-Ventilator
-Circuit (*kink, wet filter, pooling*)
-**ET tube** (*kink, plug, secretions*)
-Airways (*bronchospasm…)*

(ii) High alveolar pressure, poor compliance
(high PIP & Pplat):
-**Hyperinflation**/ Gas trapping
-Lungs (*Pulm oedema, consolidatn…)*
-**Pleural space (*pneumothorax*)**
-Chest wall compliance reduced.
-**Patient**: *dysynchrony, agitation, cough*

Approach to high airway Pressure:

1) Quick check: -Airway: Circuit/ET tube.
-Lungs: Air entry and BS.
-Patient: Agitation

2) If no obv cause check: -Pplat.
(i) Normal Pplat = airway resistance issue -> Fix.

(ii) High Pplat = Lung/chest complicance issue.
→ Treat cause if possible.
→ Otherwise reduce Vt in 1ml/kg steps.

3) If uncertain: Disconnect from ventilator and bag.
-eliminates ventilator and circuit.
-if still hard to ventilate issue = tube or patient.

Hypoxia/ Desaturation: O2sats <90% or fall >5%.

Causes of Desaturation:

O2 supply.

Ventilator/settings. (Vt, RR, PIP)
Circuit.

Airway. (Tube Obstructn/kink).

Ventilation. (?Adequate.
endobronchial intubation,
bronchospasm, Pneumothorax)

Lungs. (Pulm oedema, consolidation,
collapse. PE).

Patient. (Poor CO, increased uptake).

Approach to Desaturation:

1) Quick steps: -Check pulse ox. (correspond to ECG)
-Increase FiO2 to 1.0
-Check if chest is moving.
(i) Chest NOT moving: Manually ventilate.
->Easy: Ventilator problem – Check settings/fx.

->Hard: ETT/Patient problem. CHECK:
-ET Tube: Pass suction catheter.
-Ventilatn: AE bilat? (endobronch int, pneumothorax)
-Lungs: BS (brochospasm/air trapping, pulm oedema, collapse…)
-Patient (agitated/fighting).

(ii) Chest Moving. Examine AE, BS and patient as above.

2) Treat cause. +/- adjust ventilator settings.

CO2 Issues:

Too High:

1) Inhaled –Check capnograph returns to zero.
2) Hypoventilation –Check settings, pressure, BS.
→ Increase RR (or Vt if low)
3) Increased production – consider fever, MH.

Too Low:
1) Airway: Oesophageal intubation, Extubat'n
2) Circuit: Air entrainment.
3) Ventilation settings: Over ventilated.
4) Gas exchange problem: Poor CO, PE, Arrest.
5) Reduced production: Cold…

General Notes:

1) **Ventilation:** *(CO2 elimination improved by: ⇑RR, ⇑Vt, Reducing deadspace).*

*Titration: RR (and Tidal volume) are for titrating ventilation.
-Generally Tidal Volume stays set low for alveolar protection.
-RR is therefore the variable used.

*Monitoring: -Set PaCO2 goal (based on illness/acid base state).
-EtCO2 can be similar or lower than PaCO2.
-EtCO2 can be used to guide a RR increase if EtCO2 high.
-However low EtCO2 can be due to various other factors (eg shunt, deadspace, poor CO), so not so as accurate at guiding a reduction in RR. Check PaCO2.

2) **Oxygenation:** *(improved by: ⇑FiO2, ⇑PEEP, ⇑Insp time/Vt).*

*Titration: FiO2 and PEEP are for titrating oxygenation.
-Immediately after intubation titrate down FiO2 to achieve target O2sats.
-Adjust PEEP depending on situation.

*Monitoring: O2sats target usually used. (O2sats 88-95% ~ PaO2 55-80 mmHG).

The 2 Strategies:

1) Lung protective strategy.

Goal: Protecting lungs from ventilator associated injury. Reduces mortality.

Vt: 6-8ml/kg IBW. Low is key!
-Start with 6mls/kg if established ALI/ARDS already.
-Do not change this to meet PaCO2 goals (unless severe metab acidosis).
-Watch plateau pressure (Pplat.). This is pressure at end of inspiration when flow is zero and approximates alveolar pressure.
-If >30cm H20 then decrease Vt by 1ml/kg (min 4ml/kg) in steps until Pplat <30.

RR: Start with 18. Adjust based on CO2 and ventilatory needs.
-RR up to 30-40 are acceptable to achieve PaCO2 goal.
-Permissive hypercapnia ok if cannot achieve PaCO2 goal with rapid RR.

PEEP & FiO2: Use PEEP-FiO2 chart (from ARDSnet trial).
-Increasing FiO2 & PEEP in tandem allows alveolar recruitment. Reduces shunt.
-After intubation reduce FiO2 to 0.3-0.4 and set PEEP at 5 and titrate.

I:E ratio: (inspiratory: expiratory time).
-1:2 approximates spontaneously breathing person.
-A higher ratio 1:1.5 or 1:1 may improve oxygenation. But shortens exp time, risks gas-trapping.

Safety: Plateau pressure checks: Ensures alveolar safety. Check immed then Q30mins.
-Pplat: approximates pressure in alveoli vs Peak Pressure (which is combination of alveolar pressure and large airway and equipment resistance).
-HOW to CHECK: 1) Press the "inspiratory hold button".
2) Press "Values" button to screen 4 and Pplat will show.

2) Obstructive strategy.

Goal: Give as much expiratory time as possible.
***Remember: keep treating the underlying obstructive cause pharmacologically.*

Vt: 6-8 ml/kg IBW.

RR: Start at 8 breaths per minute.
-Keep low to avoid gas/air trapping and auto-PEEP.
-Inevitably become hypercapnic.

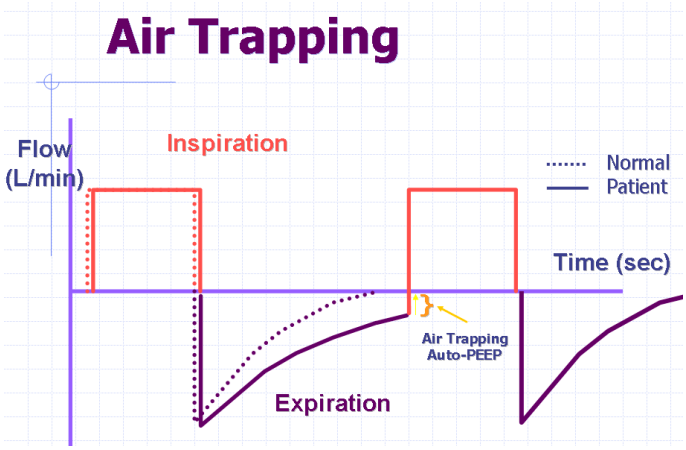
PEEP & FiO2:
-Usually only small increase in FiO2 is needed, high levels unnecessary.
-PEEP should be 0 in asthma. Too much PEEP can be bad here.
-PEEP in COPD: a small amount can be used but should be ≤5cmH20 (?help dynamic expiratory airway collapse). Lack of evidence for this.

I:E ratio: 1:4-1:5.
-Increases expiratory time to avoid gas trapping.

Peak Pressure alarm: Does not reflect alveolar pressure.
-Peak pressure often high in these patients due to large airways resistance.
-High peak pressure is needed to ventilate past obstruction, these pressures are not necessarily transmitted all the way to alveoli, so are not causing damage!
-Ensure satis alveolar ventilatn: Increase alarm setting until Vt (6-8mls/kg) given.
-Check Pplat remains <30 cmH20 (it should as long as no gas trapping).

Permissive Hypercapnia:
-Allow hypercapnia but aim to keep pH >7.1.
-Patients will need a heap of sedation/opioids. Paralysis not needed if sedated enough.

Safety: check for Airtrapping & Autopeep:
-Occurs if not enough time to exhale fully.
-Can lead to barotrauma, reduced VR, hypotension and CV collapse.
-HOW to CHECK no airtrapping:
1) Flow vs time graph: check exp flow returns to baseline before next breath.
2) Pplat: If elevated suggests airtrapping .
-Solution: reduce RR further.
**If CV collapse – disconnect from ventilator to allow exhalation of possible air trapping.



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