Guideline for the use of Routine and Emergency Manual Ventilation in the Mechanically Ventilated Patient

University Hospitals of Leicester NHS
NHS Trust

Trust reference: B13/2017

1. Introduction and Who Guideline applies to

1.1 This guideline and competency assessment has been developed for use by nurses, doctors and physiotherapists who are required to use a Mapleson-C bagging circuit to manually ventilate adult patients ventilated by endotracheal tube or tracheostomy.

1.2 All doctors, and nursing staff who regularly care for mechanically ventilated patients, or patients with tracheostomies, must be assessed as competent to manually ventilate a patient, and use manual ventilation in an emergency.

1.3 Assessment should be by a nurse, doctor or physiotherapist who has been assessed as competent themselves, and should be recorded on the associated competency framework document.

1.4 All staff should adhere to trust and individual department standard operating procedures (SOP) and/or guidelines regarding infection prevention and personal protective equipment such as the SOP for therapists delivering airway clearance techniques.

2. Guideline Standards and Procedures

2.1 Manual ventilation involves using a Mapleson-C bagging circuit to breathe for the patient.

2.2 The aim of this technique is to deliver tidal volume breaths to maintain adequate respiratory rate and tidal volume for gas transfer to occur.

2.3 The pressures generated should normally be no more than 20-25cmH_2O, aiming for a respiratory rate of 12-18 breaths per minute.

2.4 End tidal CO_2, oxygen saturations and cardiovascular stability should be monitored throughout.

2.5 In the event of an adverse reaction to manual ventilation, the patient should be reconnected to a ventilator at the earliest opportunity, and assistance sought from the medical team immediately.

2.6 Indications for manual ventilation

a) Change of ventilator circuit from dry to wet, or due for change of tubing
b) During transport, for example from theatres to ICU
c) Ventilator failure

2.7 Non-essential disconnection should be avoided in patients who are:

a) very dependent on PEEP (PEEP > 8 cm H20)
b) require >60% oxygen concentration
c) cardiovascularly or neurologically unstable.

2.8 The following assessments should be undertaken before, after, and, whereappropriate, throughout the duration of manual ventilation.

a) Observation of the patient (including respiratory distress, fatigue,neurological status and work of breathing)
b) Airway pressure readings from ventilator or manometer
c) Cardiovascular stability
d) Oxygen saturations
e) Respiratory rate

f) End-tidal CO_2

If a mechanically ventilated patient has rapidly deteriorating oxygen levels, and has not responded to an increase in in oxygen concentration up to 100%, it may be necessary to disconnect the patient from the ventilator and manually ventilate them as an emergency. Considerations in this situation are:

g) The technique used will be similar to that of manual ventilation, but in an emergency you may need to squeeze the bag harder and generate much higher pressures in order ventilate the lungs adequately.

h) You can use the manometer to record the pressures generated for future reference, but it is important that the main focus is on maintaining adequate ventilation and oxygen saturations.

i) In this situation, you should call for medical help straight away, using the crash call alarm if needed.

2.9 To use the techniques above the following equipment will be required.

a) Mapleson-C bagging circuit (Fig. 2)

b) Manometer (Fig.3) (within Mapleson-C pack, but needs placing in circuitprior to use). A manometer MUST be placed in EVERY circuit.

c) Bacterial/HME filter (Fig. 4)

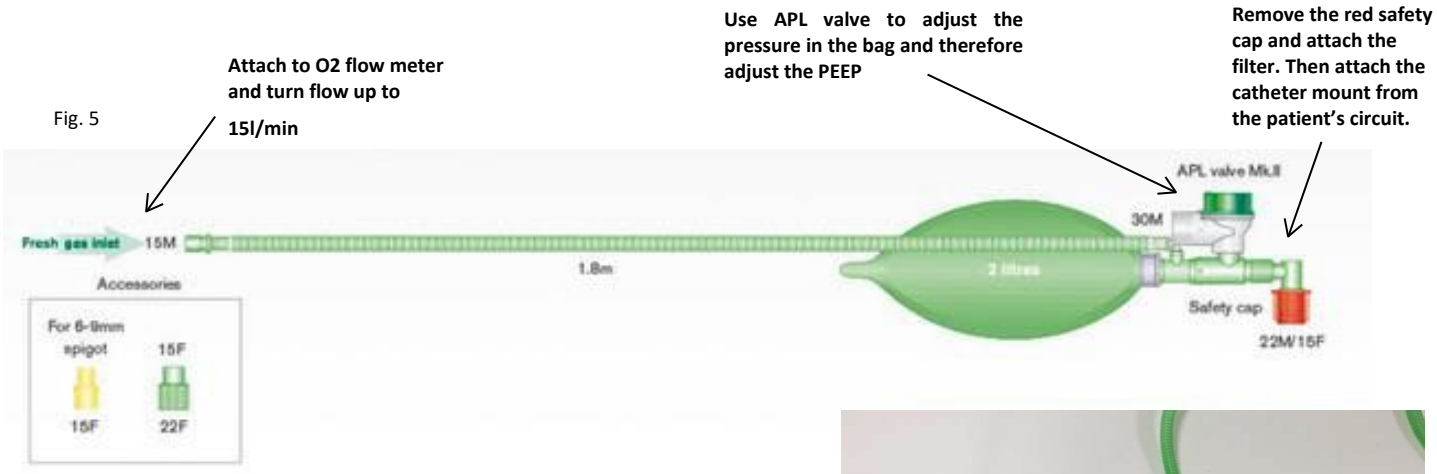
Fig. 2

Fig.3

Fig.4

2.10 The circuit will come set up as shown in Fig.5, with the manometer placed in the circuit as shown in Fig. 6.

Fig. 5



Place the manometer between the HME filter and the catheter mount

Fig. 6

2.11 Procedure

ACTION	RATIONALE
1. Ensure patient is appropriate to be disconnected from the ventilator at this time.	If the patient has a high PEEP dependency ($\geq$8cmH_2O), is on $\geq$60% oxygen concentration, or is cardiovascularly or neurologically unstable, it may be safer to delay non-essential disconnection and reassess the patient again later.
2. Follow the relevant Infection Prevention procedures for the patient as per UHL Trust Infection Prevention Policy (Trust Ref B9/2006)	Gloves and an apron should always be worn to protect yourself and the patient. It may be necessary to wear a face mask for some patients. You should ensure you have been assessed and fitted with the appropriate mask for your protection.
3. Inform the patient of what you are about to do.	Compliance with treatment and patient experience will be better if the patient is aware of the treatment and what it involves.
4. Remove the red safety cap from the patient end of the circuit and attach filter. Attach green tubing from the Mapleson- C circuit to the oxygen flow meter, and turn the flow up to 15l/min. Cover the patient end of the circuit with your gloved hand to ensure that the bag inflates.	This ensures the circuit is correctly assembled before connection to the patient. Please refer to the troubleshooting section if you detect a problem with the circuit.
5. Disconnect the patient from the ventilator, and attach the patient end of the circuit to the end of the catheter mount. You may need help from a second person to do this. Start manual ventilation straight away. You may need to silence the ventilator alarms, or put the ventilator on standby temporarily.	The patient may not be taking any spontaneous breaths, so it is important to start manual ventilation straight away. It is important to silence the ventilator alarms following disconnection to ensure the patient remains calm. You should follow the guidance for your ICU on whether to silence the alarms or put the ventilator on standby.
6. Squeeze the green bag with one hand. The bag holds 2l of oxygen, so you do not need to empty the bag completely when you squeeze. Adjust the APL valve to ensure you have enough pressure in the bag to deliver an adequate tidal volume, but not so much pressure that the bag is stiff and difficult to squeeze. Use the manometer to guide how hard you squeeze the bag – remember you should not be generating pressures of more than 20-25cmH_2O.	Manual ventilation is purely to maintain adequate ventilation whilst disconnected from the ventilator, so excessive pressures or hyperinflation should not be used.

ACTION	RATIONALE
7. You should aim to deliver 12-18 breaths per minute. If the patient is taking spontaneous breaths, you may be able to synchronise with their breathing.	Delivering a very fast respiratory rate can cause hyperventilation and patient distress. Likewise, a rate that is too slow can cause hypoventilation and impair gas exchange. Synchronising the breaths you deliver with the patient's own breathing helps to improve comfort.
8. Monitor the patient closely for equal chest movement, acceptable oxygen saturations, cardiovascular and neurological stability throughout.	Any deterioration needs to be identified quickly to ensure timely return to the ventilator and assistance from the medical team.
9. When you no longer need to manually ventilate the patient, you should turn the ventilator back on if it has been put on standby, and check that all the settings are correct before returning the patientto the ventilator. Inform the patient that this is what you are doing.	These are important safety checks as settings may have been altered accidentally during disconnection. Informing the patient helps to improve synchrony on return to the ventilator.
10. Once the patient is safely back on the ventilator, you can start to pack away the bagging circuit. Ensure the HME filter is not left in the patient's circuit, particularly if they are on a wet circuit.	The red safety cap should be placed back onto the patient end of the Mapleson-C circuit for infection control purposes. Leaving a HME filter in the circuit can cause it to become water-logged and impair ventilation.

2.12 Troubleshooting

Problem	Possible cause	Action
Inadequate tidal volume	APL valve open too far	Close APL valve more
	Inadequate flow rate	Ensure flow meter connected at 15l/min
	Punctured bag	Check bag for punctures, return patient to ventilator immediately if puncture discovered
	Other problem with circuit	Check all circuit connections
Bag over-inflating	APL valve too far closed	Open up APL valve
Resistance to inspiratory flow	Poor lung compliance i.e. bronchospasm	Check pressures on manometer for safety, return to ventilator immediately
	Obstructed ET tube/trache	Try to suction to clear the airway, if resistance remains, return patient to ventilator and inform medical team
	Expanding pneumothorax	Return to ventilator if pneumothorax suspected
Clinical deterioration of patient	Mucus plugging (“plugging off”)	Attempt to clear with suction, if unable to clear, patient should be returned to ventilator and medical team called
	Cardiovascular instability	Return to ventilator and inform medical team
	Pneumothorax	Return to ventilator and inform medical team
	Bronchospasm	Return to ventilator and administer Salbutamol nebuliser if prescribed and appropriate
	Respiratory distress	Try to synchronise breaths with patient, if unable, return patient to ventilator

3 Education and Training

Training and competency assessment in line with the guideline will be provided to physiotherapy staff within respiratory on-call training, and to nurses and medical staff within initial induction. Assessment of competence will be against the following statements:

3.1 Knowledge

a) Understands the indications for manual ventilation

b) Understands the contraindications and precautions for manual ventilation, and disconnection from the ventilator

c) Aware of the risks and complications of manual ventilation and how these can be addressed

d) Understands the physiology of manual ventilation, and the physiological changes that may occur in the patient

e) Demonstrates good knowledge of respiratory anatomy

f) Demonstrates knowledge of which clinical parameters to monitor before, during and after manual ventilation

g) Demonstrates knowledge of necessary actions in the event of a medical emergency during manual ventilation

3.2 Preparation

a) Assembles Mapleson-C circuit correctly with manometer and filter in the circuit

b) Attaches the circuit to an O2 supply at the correct flow rate

c) Ensures the circuit is functioning correctly before connection to the patient

d) Undertakes baseline observations of patient

e) Observes infection control procedures

3.3 Demonstration of technique

a) Attaches the circuit to the patient, silencing the ventilator alarms or placing on standby as appropriate

b) Demonstrates competent manual ventilation technique

c) Able to assess pressures delivered accurately using manometer

d) Able to deliver desired pressure and adjust APL valve accordingly to increase or reduce pressure

e) Monitors relevant clinical parameters throughout

f) Able to problem solve any issues, and takes appropriate action in response to adverse reaction to manual ventilation

g) Reconnects patient back to ventilator correctly

h) Ensures patient observations remain acceptable

i) Cleans equipment in line with infection control policy

j) Correct disposal of waste

Competency frameworks can be obtained from the Education and Practice Development Team.

4 Monitoring Compliance

What will be measured to monitor	How will compliance be monitored	Monitoring Lead	Frequency	Reporting arrangements
Presence of manometer in Mapleson-C circuit	Spot-check audit	Clinical Specialist Physiotherapist	Yearly	To ICU Core Group
Completion of competency assessment	Audit of staff with completed competency assessment	Clinical Specialist Physiotherapist	Yearly	To ICU Core Group

5 Supporting References

Haake R et al. Barotrauma: Pathophysiology, risk factors and prevention.Chest 1987; 91: 608-613

Main, E. and Denehy, L. (2016) Cardiorespiratory Physiotherapy: Adults andPaediatrics. 5th Ed. London: Elsevier.

Partaz J. Haemodynamic stability of the ventilated intensive carepatient: A review. Australian Journal of Physiotherapy 1992; 1992: 167-172

UHL Infection Prevention Policy (Trust Ref B9/2006)

UHL Therapists Delivering Airway Clearance Techniques

6 Key Words

Manual ventilation, manual hyperinflation, intensive care, physiotherapy.

CONTACT AND REVIEW DETAILS	
Guideline Lead Anna Makower, Clinical Specialist Physiotherapist	**Executive Lead** Lynne Cooke, Head of Therapies
Details of Changes made during review: new guideline (approved 17.3.17 – Policy and Guideline Committee) September 2018 – review June 2021 – review no changes	