

Manual Hyperinflation (MHI) Physiotherapy Guidelines

AIM: Safe use of manual hyperinflation techniques to manage and prevent respiratory failure

Manual Hyperinflation (MHI) Physiotherapy Guidelines

Introduction

Manual hyperinflation is a technique that uses a manual resuscitation circuit to provide a larger than baseline tidal volume to the lungs of a patient who is intubated. If MHI is to be used, patients need to be carefully selected, a manometer needs to be included in the circuit, an optimal treatment regime needs to be established and the operator needs appropriate training (Ball et al, 2005). In view of this, these guidelines aim to provide a basis for effective and safe use of MHI.

Definitions

The use of the terminology “bagging” and “bag squeezing” is misleading and extremely subjective. There are three separate definitions when using a manual resuscitation circuit:

Manual Ventilation = delivering FiO₂ 1.0 at tidal volume to the patient e.g. whilst changing ventilator tubing, trialling spontaneous breathing.

Manual Hyperventilation = rapid breaths delivering FiO₂ 1.0 at or greater than TV to reverse hypoxaemia and improve oxygenations e.g. during a sudden desaturation.

Manual Hyperinflation = slow, deep breaths at greater than TV used to increase lung volume. A therapeutic manoeuvre often accompanied with other treatment techniques (positioning, manual techniques) e.g. to reverse lobar atelectasis.

Indications

- Acute lobar atelectasis (ALA)
- To mobilise secretions
- Improve respiratory mechanics (increase compliance, reduced resistance)
- To improve gas exchange

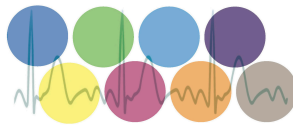
Patient selection

There is conflicting evidence in the use of MHI. Deciding on which patients will benefit from the procedure without causing adverse effects can be challenging. It is also difficult to ascertain which patients are likely to deteriorate without its use; therefore, a clear definitive clinical indication for its use is of the utmost importance.

Authors: Fern Freeman, Respiratory Physiotherapy; Credit from previous version 2009 to Phil Howard, Senior Lead Physiotherapy

◇ Date: 31/05/2020

◇ Revision Due: 31/05/2022



On review of the studies on MHI, several recommendations prior to its use can be made which are well documented in the current evidence base.

Respiratory status

- Stable ETT, Tracheostomy position
- FiO₂ <0.75 provided SaO₂ >95% and PaO₂ >9.0
- PEEP <10cmH₂
- Peak/Pinsp <30cmH₂O
- TV <6mls/Kg (unless on lung protective strategy)

CVS Status

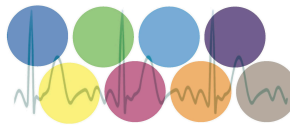
- Systolic BP >100mmHg
- MAP >60mmHg <110mmHg with fluctuation <15mmHg on position change
- HR <130
- CVP >8 (if no PEEP is provided)
- CO >4.0l/min
- No arrhythmias compromising cardiovascular function

Neurological status

- ICP <15mmHg
- CPP >70mmHg
- Pain well controlled
- No fitting in last 72 hours
- Sedation scale <2

Other parameters to consider during assessment

- presence of "wheeze" on auscultation
- level of inotropic and/or vasopressor support <1mg Noradrenaline
- Volume of fluid loss from drains (especially chest)
- Stability of external pacing wires, lines, drains etc.
- Abdominal size and pressure <15cmH₂O
- Previous/recent medical and surgical history (particularly previous lung pathology)



Contraindications

There are no absolute contraindications in the literature, however it is strongly recommended that the procedure is not used in the following conditions unless there is explicit agreement from the medical team:

- Undrained pneumothorax
- Severe bronchospasm
- Cardiovascular instability
- Acute head injury / Neurosurgery 0-72 hours
- Increased levels of respiratory support (PEEP >10cmH20)

Precautions

The following are less severe but again, discussion with medical/surgical team is vital to ascertain efficacy and safety of the technique. In many the technique if MHI will need to be adapted so as to prevent possible side effects.

- Emphysematous bullae
- Renal dialysis
- Recent lung surgery
- Patients at risk of barotrauma
- Rib fracture (especially in the presence of flail segments)
- Hypoxic driven COPD/ Acute exacerbation of COPD
- Significant pain
- Surgical emphysema/drained pneumothorax
- Air leaks
- ARDS
- Haemoptysis
- Broncho-pleural/broncho-oesophageal fistula

Equipment

- 2L reservoir bag with adjustable valve (kept at the patient's bedside)
- Oxygen supply (turned up to 15L/min)
- Pressure manometer and pressure line
- HME bacterial filter
- Suction equipment
- Infection control measures – apron, gloves, mask, goggles (as indicated)



X



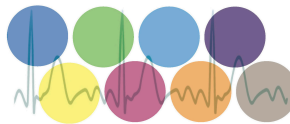
Images taken from:

www.flexicare.com/products/anaesthesia-breathing-systems/adult-anaesthesia-circuits/mapleson-c

www.stgeorges.nhs.uk/wp-content/uploads/2013/08/trach15-219x300.jpg

www.yms.co.za/wp-content/uploads/2015/03/Bacterial_HME_Fi_4c6185a2cfdc7.jpg

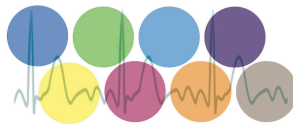
*****COVID 19 UPDATE*** - In light of the pandemic, please ensure to use a viral filter within your MHI circuit.**



Procedure

The following procedure is based on the best available evidence.

- Perform thorough assessment addressing all aspects and appropriateness of technique
- Liaise with medical/surgical team about treatment safety/indication as required
- Obtain consent from patient if able
- Collect and assemble appropriate equipment (as above) and check the bag for leaks or problems with the valve
- Set O2 flow rate to 15l/min
- Ensure analgesia/ sedation and fluid balance is optimal if appropriate
- Reassure patient and explain thoroughly the procedure. If appropriate inform the patient of any symbol to use if they wish to stop
- Position patient appropriately based on assessment
- If ventilated, disconnect from ventilator/CPAP and apply bag via catheter mount. If self-ventilating via tracheostomy, remove oxygen supply and connect as above. Note: ensure cuff inflated for procedure to a safe pressure.
- Using small volumes initially, adjust valve until chest expansion can be seen/felt to be increasing and firm pressure is required to empty the bag, always be mindful of peak airway pressure.
- Perform slow, deep inspirations, observing the manometer with a two-handed technique and rotating action. Ensure pressure does not exceed 40cmH2O
- Aim to deliver 1.5 times the TV of the ventilator i.e. a 50% increase, careful not to over expand.
- Expansion should be gauged by another clinician, ideally the physiotherapist doing manual techniques.
- Apical compression can be used during inspiratory phase to redirect positive pressure basally and mobilise distal secretions.
- Maximum inflation and pressure should be held for 1-2 seconds then a quick release is performed with manual techniques as indicated. A full expiration must occur prior to repetition to avoid intrinsic PEEP.
- If the patient is deemed stable use 6-8 MHI breaths to 6-8 TV breaths. If there is a likelihood of side effects, reduce the ratio i.e. 1-2 MHI breaths to 8-10 TV breaths. This depends greatly on the patient tolerance the indication for MHI to be used.
- Stop if adverse effects continue to occur or the patient requests/ appears distressed.
- Suction if palpable fremitus is felt or heard in the bag.



- The duration of MHI/ number of cycles with depends on several factors but appropriate outcome measures should be used to assess efficacy of the technique.
- When it is deemed MHI has finished, inform the patient, reattach to the ventilator/ O2 supply and re-assess.
- If the patient is stable, position post treatment to maximise benefits of MHI.
- Document treatment and outcomes.

Measuring outcomes

It is important to document any outcomes of intervention, positive as well as negative. In the literature, the most common outcomes include:

- Sputum – amount/volume, colour, tenacity
- Gas exchange – SaO₂, PaO₂, PaO₂/FiO₂ ratio
- Ventilator adequacy – PaCO₂, ETCO₂, TV
- Compliance - TV/Peak – PEEP (record as mL/cmH₂O)
- Auscultation/palpation/percussion – breath sounds, added sounds, resonance, palpable fremitus, expansion.

Competency

- All physiotherapists must undergo appropriate training and complete the competency forms before attempting to use MHI.
- Training is currently being delivered via the on-call course, on call update or on a one to one basis as requested. All staff should maintain competency with using the equipment and follow up on any identified learning needs. This should be addressed at annual KSF review, where staff will be expected to show appropriate evidence.
- Staff using this equipment should be able to:
 - Demonstrate correct use of equipment
 - Understand the rationale behind contraindications to its use and any relevant cautions/precautions.
 - Modify treatment techniques in response to recognised complications, adverse reactions or therapeutic changes.
 - Adequately clean equipment and dispose of any wastes, with adherence to appropriate infection control measures.
 - Evaluate and record its therapeutic use with appropriate outcome measures.
- It is the responsibility for an individual to maintain competency with equipment used as per professional guidance. Any adverse effects must be reported to a respiratory senior and datix completed where indicated.



Maintenance

If the bag appears damaged in any way dispose of it in a clinical waste bag and obtain a new circuit. If the interface is damaged/ soiled replace this.

Document Details		
Title	Manual Hyperinflation (MHI) Physiotherapy Guidelines	
Main points the document covers	Definition, equipment, safe technique	
Who is the document aimed at?	Physiotherapy Team, Critical Care Team	
Author	Fern Freeman, Respiratory Physiotherapy (current version 2020) Phil Howard, Senior Lead Physiotherapy (previous version (2009))	
Approval process		
Approved by	PENDING - CRITICAL CARE CLINICAL GOVERNANCE	
Effective from	July 2020	
Category	Critical Care	
Sub-Category	Respiratory Physiotherapy	
Review date		
Document Links		
Required by CQC	Recommended	
Required by NHSLA	Recommended	
Other		
External references used		
<ol style="list-style-type: none"> Anderson, A, Alexanders, J, Sinani, C, Hayes, S, Fogarty, M. (2015), Effects of ventilator vs manual hyperinflation in adults receiving mechanical ventilation: a systematic review of randomised control trials, <i>Physiotherapy</i>. 101:2, 103-110 Pathmanathan, N, Beaumont, N, Gratrix, A. (2014). Respiratory physiotherapy in the critical care unit, <i>Education in Anaesthesia, Critical Care and Pain</i>,15:2 		
Amendments History		
No	Date	Amendment
1		
2		
3		
4		
5		

Authors: Fern Freeman, Respiratory Physiotherapy; Credit from previous version 2009 to Phil Howard, Senior Lead Physiotherapy

◇ Date: 31/05/2020

◇ Revision Due: 31/05/2022