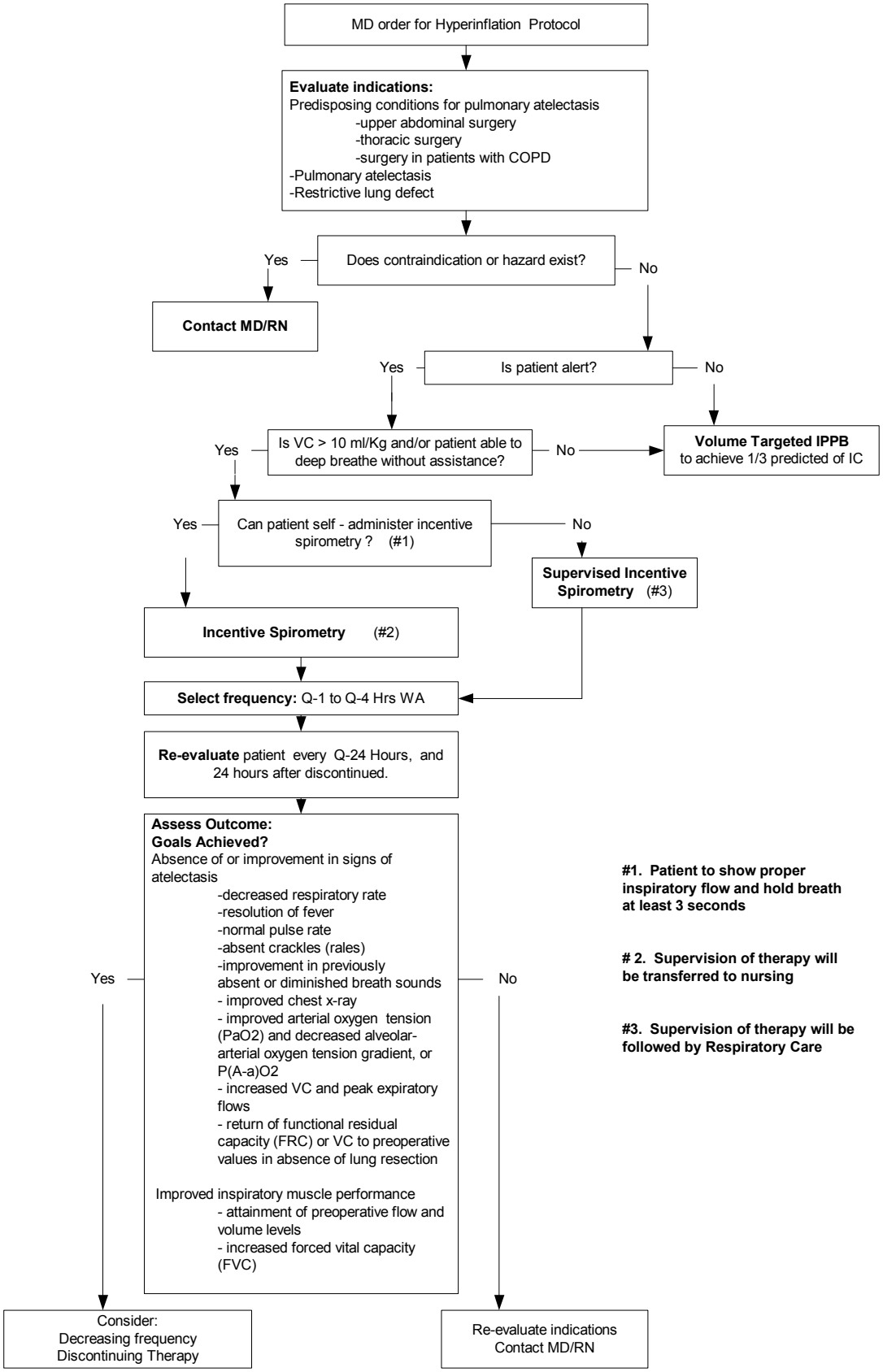
HYPERINFLATION PROTOCOL



5/5/03 (Jan Phillips-Clar, Rick Ford, Judy Tietsort, Jay Peters, David Vines)

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AARC Hyperinflation Protocol algorithm

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AARC Clinical Practice Guideline

Incentive Spirometry

IS 1.0 PROCEDURE:

Incentive spirometry, also referred to as sustained maximal inspiration (SMI), is a component of bronchial hygiene therapy.(1-3)

IS 2.0 DESCRIPTION/DEFINITION:

2.1 Incentive spirometry is designed to mimic natural sighing or yawning by encouraging the patient to take long, slow, deep breaths.(1,2,4,5) This is accomplished by using a device that provides patients with visual or other positive feedback when they inhale at a predetermined flowrate or volume and sustain the inflation for a minimum of 3 seconds.(2,3,5-7)

The objectives of this procedure are to increase transpulmonary pressure and inspiratory volumes, improve inspiratory muscle perfor-mance,8 and re-establish or simulate the normal pattern of pulmonary hyperinflation.3 When the procedure is repeated on a regular basis, airway patency may be maintained and lung atelectasis prevented and reversed.(1-3,5,6,9,10)

2.2 Incentive spirometry should be contrasted with expiratory maneuvers (such as the use of blow bottles) that do not mimic the sigh and have been associated with the production of reduced lung volumes.(5,6)

IS 3.0 SETTINGS:

3.1 Critical care

3.2 Acute care inpatient

3.3 Extended care and skilled nursing facility

3.4 Home care(8)

IS 4.0 INDICATIONS:

4.1 Presence of conditions predisposing to the development of pulmonary atelectasis

4.1.1 upper-abdominal surgery(2,4,9-14)

4.1.2 thoracic surgery(9,10,13-15)

4.1.3 surgery in patients with chronic obstructive pulmonary disease (COPD)(7,13-15)

4.2 Presence of pulmonary atelectasis(16)

4.3 Presence of a restrictive lung defect associated with quadraplegia and/or dysfunctional diaphragm.(6,8,14,17,18)

IS 5.0 CONTRAINDICATIONS:

5.1 Patient cannot be instructed or supervised to assure appropriate use of the device.

5.2 Patient cooperation is absent(2,16) or patient is unable to understand or demonstrate proper use of the device.(16)

5.3 IS is contraindicated in patients unable to deep breathe effectively (eg, with vital capacity [VC] less than about 10 mL/kg or inspiratory capacity [IC] less than about one third of predicted).

5.4 The presence of an open tracheal stoma is not a contraindication but requires adaptation of the spirometer.

IS 6.0 HAZARDS AND COMPLICATIONS:

6.1 Ineffective unless closely supervised or performed as ordered(6)

6.2 Inappropriate as sole treatment for major lung collapse or consolidation

6.3 Hyperventilation

6.4 Barotrauma (emphysematous lungs)(19)

6.5 Discomfort secondary to inadequate pain control(15,18)

6.6 Hypoxia secondary to interruption of prescribed oxygen therapy if face mask or shield is being used

6.7 Exacerbation of bronchospasm

6.8 Fatigue(20,21)

IS 7.0 LIMITATIONS OF METHOD:

Evidence suggests that deep breathing alone without mechanical aides can be as beneficial as incentive spirometry in preventing or reversing pulmonary complications,(1-5) and controversy exists concerning overuse of the procedure.(1,4,6)

IS 8.0 ASSESSMENT OF NEED:

8.1 Surgical procedure involving upper abdomen or thorax(4,5)

8.2 Conditions predisposing to development of atelectasis including immobility, poor pain control, and abdominal binders

8.3 Presence of neuromuscular disease involving respiratory musculature(8)

IS 9.0 ASSESSMENT OF OUTCOME:

9.1 Absence of or improvement in signs of atelectasis

9.1.1 decreased respiratory rate(16,17)

9.1.2 resolution of fever(2,18)

9.1.3 normal pulse rate(14)

9.1.4 absent crackles (rales)(20) or presence of or improvement in previously absent or diminished breath sounds

9.1.5 normal chest x-ray(2)

9.1.6 improved arterial oxygen tension (PaO2) and decreased alveolar-arterial oxygen tension gradient, or P(A-a)O2(1,3,4,9,10)

9.1.7 increased VC and peak expiratory flows(4,16,17)

9.1.8 return of functional residual capacity (FRC) or VC to preoperative values4,(15-17) in absence of lung resection

9.2 Improved inspiratory muscle perfor-mance

9.2.1 attainment of preoperative flow and volume levels1(1)

9.2.2 increased forced vital capacity (FVC)

IS 10.0 RESOURCES:

10.1Equipment

10.1.1 incentive spirometer

10.1.2 conclusive evidence to support the use of one type or brand of device over others is lacking(20,22)

10.2 Personnel

10.2.1 Level I personnel should possess

10.2.1.1 mastery of techniques for proper operation and clinical application of device(6) and understanding of the importance of effective postopera-tive pain relief(15,16,18) and the absence of other impediments to patient cooperation (such as residual anesthetic or sensory impairment(12,17))

10.2.1.2 ability to instruct patient in proper technique(2,6) and an under-standing of the importance of preoperative instruction and supervised practice

10.2.1.3 ability to respond appropriately to adverse effects

10.2.1.4 knowledge of and ability to implement Universal Precautions

10.2.2 Level II personnel, in addition to possessing knowledge and abilities described in 10.2.1.1-10.2.1.4, should have demonstrated ability to assess patient need for and response to therapy and recommend modifications and discontinu-ance as appropriate.

IS 11.0 MONITORING:

Direct supervision of every patient performance is not necessary once the patient has demonstrated mastery of technique;(6,16,23) however, preoperative instruction, volume goals, and feedback are essential to optimal performance.

11.1 Observation of patient performance and utilization
11.1.1 frequency of sessions(16)
11.1.2 number of breaths/session(16)
11.1.3 inspiratory volume or flow goals achieved(16) and 3- to 5-second breath-hold maintained
11.1.4 effort/motivation(16)
11.2 Periodic observation of patient compliance with technique,(6,16,23) with additional instruction as necessary
11.3 Device within reach of patient(5) and patient encouraged to perform independently
11.4 New and increasing inspiratory volumes established each day
11.5 Vital signs

IS 12.0 FREQUENCY:

A number of authors suggest using the device 5-10 breaths per session, at a minimum, every hour while awake (ie, 100 times a day).(2,7,19) *Caregiver does not need to be present with each performance, and patient should be encouraged to perform independently.*

IS 13.0 INFECTION CONTROL:

13.1 Universal Precautions(24)
13.2 Proper labeling and appropriate storage of devices between uses and appropriate cleaning of devices between patients(25)

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AARC Clinical Practice Guideline

Intermittent Positive Pressure Breathing

IPPB 1.0 PROCEDURE:
Intermittent positive pressure breathing

IPPB 2.0 DESCRIPTION/DEFINITION:
IPPB is a technique used to provide short-term or intermittent mechanical ventilation for the purpose of augmenting lung expansion, delivering aerosol medication, or assisting ventilation(1)

2.1 IPPB is not a therapy of first choice for aerosol delivery or lung expansion in spontaneously breathing patients when other less expensive and less invasive therapies can reliably meet clinical objectives.(2-8)

2.2 IPPB can include volume-, pressure-, time-limited, or flow-cycled ventilation.

2.3 IPPB may be applied to intubated as well as nonintubated patients.

IPPB 3.0 SETTINGS:
IPPB can be administered in settings that include hospital, clinic, extended care facility, and home.

IPPB 4.0 INDICATIONS:

4.1 The need to improve lung expansion

4.1.1 The presence of clinically important pulmonary atelectasis when other forms of therapy have been unsuccessful (incentive spirometry, chest physiotherapy, deep breathing exercises, positive airway pressure) or the patient cannot cooperate(9-l4)

4.1.2 Inability to clear secretions adequately because of pathology that severely limits the ability to ventilate or cough effectively and failure to respond to other modes of treatment(13)

4.2 The need for short-term ventilatory support for patients for are hypoventilated as an alternative to tracheal intubation and continuous ventilatory support(12-2l)

4.3 The need to deliver aerosol medication (We are not addressing aerosol delivery for patients on long-term mechanical ventilation)(4)

4.3.1 Although some authors oppose the use of IPPB in the treatment of severe bronchospasm (acute asthma, unstable or status asthmaticus, exacerbated COPD),(6,22-24) we recommend a careful, closely supervised trial of IPPB when treatment using other techniques (metered dose inhaler [MDI] or nebulizer) has been unsuccessful(1,25-33)

4.3.2 IPPB may be used to deliver aerosol medications to patients with fatigue as a result of ventilatory muscle weakness (eg, failure to wean from mechanical ventilation, neuromuscular disease, kyphoscoliosis) or chronic conditions in which intermittent ventilatory support is indicated (eg, ventilatory support for home care patients and the more recent use of nasal IPPV for respiratory insufficiency).(l,l5-2l)

IPPB 5.0 CONTRAINDICATIONS:
Although no absolute contraindications to the use of IPPB therapy (except the oft-cited tension pneumothorax) have been reported, the patient with any of the following should be carefully evaluated before a decision is made to initiate IPPB therapy.

5.1 Intracranial pressure (ICP) > 15 mm Hg

5.2 Hemodynamic instability

5.3 Recent facial, oral, or skull surgery

5.4 Tracheoesophageal fistula

5.5 Recent esophageal surgery

5.6 Active hemoptysis

5.7 Nausea

5.8 Air swallowing

5.9 Active untreated tuberculosis

5.10 Radiographic evidence of bleb
5.11 Singulation (hiccups)

IPPB 6.0 HAZARDS/COMPLICATIONS:

6.1 Increased airway resistance(34)
6.2 Barotrauma, pneumothorax(34)
6.3 Nosocomial infection(34)
6.4 Hypocarbia(4,35)
6.5 Hemoptysis(4,35)
6.6 Hyperoxia when oxygen is the gas source(34)
6.7 Gastric distention(34)
6.8 Impaction of secretions (associated with inadequately humidified gas mixture)(34)
6.9 Psychological dependence(34)
6.10 Impedance of venous return(34)
6.11 Exacerbation of hypoxemia
6.12 Hypoventilation
6.13 Increased mismatch of ventilation and perfusion
6.14 Air trapping, auto-PEEP, overdistended alveoli

IPPB 7.0 LIMITATIONS OF PROCEDURE OR DEVICE:

7.1 All of the mechanical effects of IPPB are short-lived--lasting < or = an hour after treatment(35,36)
7.2 Based on the available literature, MDI or compressor-driven nebulizers should be considered the devices of choice for aerosol therapy to COPD and stable asthma patients.(l,3-8)
7.3 Only a very small percentage of the aerosol output deposits in the airway.(37) Delivery of a therapeutic dose via IPPB may require as much as a tenfold increase in medication amount over MDI(38,39)
7.4 Efficacy of device for ventilation and aerosol delivery is technique dependent (eg, coordination, breathing pattern, selection of appropriate inspiratory flow, peak pressure, inspiratory hold).(40,51)
7.5 Efficacy is dependent on the design of the device (eg, flow, volume, and pressure capability as well as aerosol output and particle size).(40,42,52-54)
7.6 IPPB is equipment- and labor-intensive as a method of delivery of aerosol.(40,42,55-59)
7.7 Limited portability and lack of convenience may affect patient compliance.

IPPB 8.0 ASSESSMENT OF NEED:

8.1 Presence of atelectasis
8.2 Reduced pulmonary function as evidenced by reductions in timed volumes, and vital capacity (eg, FEV1 < 65% predicted, FVC < 70% predicted, MVV < 50% predicted, or VC < 10 mL/kg) precluding an effective cough
8.3 Neuromuscular disorders or kyphoscoliosis with associated decreases in lung volumes and capacities
8.4 Fatigue or muscle weakness with impending respiratory failure
8.5 Presence of acute severe bronchospasm or exacerbated COPD that fails to respond to other therapy
8.5.1 Regardless of the type of delivery device used (MDI with spacer or small volume, large-volume, or ultrasonic nebulizer), it is important to recognize that the dose of the drug needs to be titrated to give the maximum benefit.(37,39)
8.5.2 Based on proven therapeutic efficacy, variety of medications, and cost-effectiveness, the MDI with accessory device should be the first method to consider for administration of aerosol.(42,55-59,6l,62)
8.6 With demonstrated effectiveness, the patient's preference for a positive pressure device should be honored.

IPPB 9.0 ASSESSMENT OF OUTCOME:

9.1 Tidal volume during IPPB greater than during spontaneous breathing (by at least 25%)
9.2 FEV1 or peak flow increase
9.3 Cough more effective with treatment
9.4 Secretion clearance enhanced as a consequence of deep breathing and coughing
9.5 Chest x-ray improved
9.6 Breath sounds improved
9.7 Favorable patient subjective response

IPPB 10.0 RESOURCES:

10.1 Equipment

10.1.1 IPPB device or pressure-support; volume-, pressure-, or time-limited ventilator or manual resuscitation device
10.1.2 Connecting tubing
10.1.3 Nebulizer (small-volume, large-volume, or ultrasonic) and medication or normal saline, or MDI with accessory adapter, or humidifier
10.1.4 Mouthpiece, flange (lip seal), nose clip, mask, or endotracheal tube adapter
10.1.5 Tissues and emesis basin or container for collecting or disposing of expectorated sputum
10.1.6 Gloves, goggles, gown, and mask as indicated
10.1.7 Hand-held spirometer or other volume-measuring device
10.1.8 Oral and/or endotracheal suction equipment
10.2 Personnel: A spectrum of education and skill levels is required for personnel who administer IPPB therapy. Different clinical situations warrant the degree of training necessary to provide optimal respiratory care:
10.2.1 Level I caregiver may be the provider of service after Level II personnel have established need for a specific device by patient assessment, and the first administration has been completed. Level I personnel must demonstrate
10.2.1.1 ability to prepare, measure, and mix medication;
10.2.1.2 proper technique for administration of medication;
10.2.1.3 proper use of equipment, including adjustment of machine settings to meet patient demands;
10.2.1.4 effective cleaning of equipment;
10.2.1.5 proper disposal of wastes;
10.2.1.6 ability to encourage effective breathing patterns and coughing techniques;
10.2.1.7 ability to modify technique (after communication with physician) in response to recognized complications and adverse reactions or change in severity of symptoms as determined by observation and vital-signs determination;
10.2.1.8 ability to implement Universal Precautions and proper infection control.
10.2.2 Level II Personnel must demonstrate all Level I skills and
10.2.2.1 ability to perform physical exam--auscultation, inspection, percussion, and vital signs;
10.2.2.2 ability to assess patient condition and patient response to therapy;
10.2.2.3 ability to perform peak expiratory flowrate, spirometry, and ventilatory mechanics measurement;
10.2.2.4 proper use and knowledge of limitations of IPPB equipment and aerosol device and ability to fit mask and/or identify best application device for particular patient;
10.2.2.5 ability to recognize and respond to therapeutic changes, adverse response, and complications of aerosol medications;
10.2.2.6 ability to modify dosage of medication and/or frequency of administration as prescribed in response to severity of symptoms;
10.2.2.7 ability to negotiate care plan and modifications with physician and healthcare team;
10.2.2.8 understanding of effects of increased pressure on ventilation, perfusion, and sputum mobilization;
10.2.2.9 ability to modify technique in response to adverse reactions;
10.2.2.10 ability to instruct patient/family/caregiver in goals of therapy and
10.2.2.10.1 proper technique for administration,
10.2.2.10.2 proper use of equip ment,
10.2.2.10.3 cleaning of equipment,
10.2.2.10.4 breathing patterns and cough techniques,
10.2.2.10.5 recognition of communications and technique modification in response to adverse reactions,
10.2.2.10.6 frequency modification in response to severity of symptoms;
10.2.2.11 understanding and compliance with Universal Precautions and infection control issues related to cleaning and maintaining equipment and handling of secretions and hazardous waste.
10.2.3 Level III--Self-administration of IPPB. Patients who are to self-administer IPPB should demonstrate to the supervising clinician
10.2.3.1 proper technique for administration;
10.2.3.2 proper use of equipment;
10.2.3.3 proper cleaning of equipment;
10.2.3.4 ability to measure and mix medications;
10.2.3.5 breathing patterns and cough techniques;

10.2.3.6 technique modification in response to adverse reactions, duration or frequency modification in response to severity of symptoms.

IPPB 11.0 MONITORING:

Items from the following list should be chosen as appropriate for the specific patient.

11.1 Performance of machine trigger sensitivity, peak pressure, flow setting, FIO2 inspiratory time, expiratory time, plateau pressure, PEEP

11.2 Respiratory rate and volume

11.3 Peak flow or FEVl/FVC

11.4 Pulse rate and rhythm from EKG if available

11.5 Patient subjective response to therapy--pain, discomfort, dyspnea

11.6 Sputum production--quantity, color, consistency, and odor

11.7 Mental function

11.8 Skin color

11.9 Breath sounds

11.10 Blood pressure

11.11 Arterial hemoglobin saturation by pulse oximetry (if hypoxemia is suspected)

11.12 Intracranial pressure (ICP) in patients for whom ICP is of critical importance

11.13 Chest radiograph

IPPB 12.0 FREQUENCY:

12.1 Critical care--q 1 h-q 6 h, for IPPB as tolerated. IPPB order should be re-evaluated at least every 24 hours based on assessments during individual treatments.

12.2 Acute/domiciliary care--

12.2.1 Common strategies for IPPB vary from *qid* to *bid*. Frequency should be determined by assessing patient response to therapy.

12.2.2 For acute care patients, order should be re-evaluated based on patient response to therapy at least every 72 hours or with any change of patient status.

12.2.3 Domiciliary patients should be reevaluated periodically and with any change of status.

IPPB 13.0 INFECTION CONTROL:(42)

13.1 Caregivers should implement Universal Precautions(63) and appropriate guidelines for prevention of tuberculosis transmission.(64)

13.2 Caregivers should observe all infection control guidelines posted for patient.

13.3 All reusable equipment should be disinfected between patients.

13.4 Nebulizers should be changed or subjected to high-level disinfection

13.4.1 at conclusion of dose administration (for single treatment), or

13.4.2 every 24 hours with continuous administration, or more often when visibly soiled.

13.5 Nebulizers should not be rinsed with tap water between treatments,(65,66) but may be rinsed with sterile water or sterile saline and allowed to air dry.

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