AARC Clinical Practice Guideline

Intermittent Positive Pressure Breathing—2003 Revision & Update

IPPB 1.0 PROCEDURE:
Intermittent positive pressure breathing

IPPB 2.0 DESCRIPTION/DEFINITION:
The first American Association for Respiratory Care (AARC) clinical practice guideline (CPG) for Intermittent Positive Pressure Breathing (IPPB) was published in 1993. Since that time there have been additional studies, systematic overviews, and a meta-analysis that specifically addresses the efficacy of IPPB as compared to other hyperinflation and aerosol delivery techniques.[1] Those studies have been added as references to this revised CPG. IPPB remains a technique used to provide short-term or intermittent mechanical ventilation for the purpose of augmenting lung expansion, delivering aerosol medication, or assisting ventilation.[2] A caveat, however, is that IPPB is not the therapy of first choice for delivering aerosol or as a method of lung hyperinflation in spontaneously breathing patients when other less expensive therapies can reliably meet the clinical objectives prescribed for the patient.[1,3-12] It should be noted that noninvasive positive pressure ventilation (NPPV) may be considered as a form of IPPB to assist ventilation, although a review of this therapeutic modality was not included in this CPG.

2.1 IPPB can include pressure- and time-limited, as well as pressure, time, and flow-cycled ventilation.

2.2 IPPB may be delivered to artificial airways and 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 significant 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[13-18]

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[17]

4.2 The need for short-term ventilatory support for patients who are hypoventilating as an alternative to tracheal intubation and continuous mechanical ventilation.[16-25] Devices specifically designed to deliver noninvasive positive pressure ventilation (NPPV) should be considered.

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

4.3.1 Some clinicians oppose the use of IPPB in the treatment of severe bronchospasm (acute asthma or status asthmaticus, and exacerbated COPD);[6,26-28] however, a careful, closely supervised trial of IPPB as a medication delivery device when treatment using other techniques (metered-dose inhaler [MDI] or nebulizer) has been unsuccessful may be warranted.[1,28-36]

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, spinal injury) 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,19-25,37]

4.3.3 In patients with severe hyperinflation, IPPB may decrease dyspnea and discomfort during nebulized therapy.[38]

IPPB 5.0 CONTRAINDICATIONS:

There are several clinical situations in which IPPB should not be used. With the exception of untreated tension pneumothorax, most of these contraindications are relative:[39]

5.1 Tension pneumothorax (untreated)
5.2 Intracranial pressure (ICP) > 15 mm Hg
5.3 Hemodynamic instability
5.4 Recent facial, oral, or skull surgery
5.5 Tracheoesophageal fistula
5.6 Recent esophageal surgery
5.7 Active hemoptysis
5.8 Nausea
5.9 Air swallowing
5.10 Active untreated tuberculosis
5.11 Radiographic evidence of bleb
5.12 Singulation (hiccups)

IPPB 6.0 HAZARDS/COMPLICATIONS:

6.1 Increased airway resistance and work of breathing[40,41]
6.2 Barotrauma, pneumothorax[40]
6.3 Nosocomial infection[40]
6.4 Hypocarbia[4,42]
6.5 Hemoptysis[4,42]
6.6 Hyperoxia when oxygen is the gas source[40]
6.7 Gastric distention[40]
6.8 Impaction of secretions (associated with inadequately humidified gas mixture)[40]
6.9 Psychological dependence[40]
6.10 Impedance of venous return[40]
6.11 Exacerbation of hypoxemia
6.12 Hypoventilation or hyperventilation
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 ≤ an hour after treatment.[42-44]
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.[1,3-8]
7.3 Only a very small percentage of the aerosolized medication optimally deposits in the airway.[45] Delivery of a therapeutic medication dose via IPPB may require as much as a tenfold increase in medication amount when compared to MDIs.[45-47]
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).[48-59]
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).[48,50,60-62]
7.6 IPPB is equipment- and labor-intensive as a method of delivery of aerosol.[48,50,63-67]
7.7 Limited portability, lack of instruction, and/or lack of 50-psi gas source may affect patient compliance.

IPPB 8.0 ASSESSMENT OF NEED:

8.1 Presence of clinically significant atelectasis
8.2 Reduced pulmonary function as evidenced by reductions in timed volumes and vital capacity (eg, FEV_1 < 65% predicted, FVC < 70% predicted, MVV < 50% predicted,[68] 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 Based on proven therapeutic efficacy, variety of medications, and cost-effectiveness, the MDI with a spacing device or holding chamber should be the first method to consider for administration of aerosol.[50,63-67,69,70]

8.5.2 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.[45,47]

8.6 With demonstrated effectiveness, the patient's preference for a positive pressure device

should be honored.

8.7 IPPB may be indicated in patients who are at risk for the development of atelectasis and are unable or unwilling to deep breathe without assistance.[71]

IPPB 9.0 ASSESSMENT OF OUTCOME:

9.1 For lung expansion therapy, a minimum delivered tidal volume of at least 1/3 of the predicted IC (1/3 x 50 mL/kg) has been suggested. This corresponds to approximately 1200 mL in a 70 kg adult patient.[71]

9.2 An increase in FEV_1 or peak flow

9.3 Cough more effective with treatment

9.4 Secretion clearance enhanced as a consequence of deep breathing and coughing

9.5 Chest radiograph improved

9.6 Breath sounds improved

9.7 Favorable patient subjective response

IPPB 10.0 RESOURCES:

10.1 Equipment:

10.1.1 IPPB devices can be pneumatically driven or electrically powered. They are usually categorized as patient-triggered, pressure- or flow-cycled mechanical ventilators.[39]

10.1.2 Most IPPB devices require a 45-55 psi gas pressure source (eg, compressed gas cylinder, bulk gas system, external or internal air compressor).

10.1.3 Single-use IPPB devices are now available for providing short-term or intermittent mechanical ventilation, augmenting hyperinflation and delivering aerosols.

10.1.3.1 Single-use IPPB devices are not equipped with a redundant pop-off valve and thus should not be used with an endotracheal tube, and used only cautiously with a mask.

10.1.3.2 Tidal volume may be determined by using the tidal volume chart included with single-use IPPB instructions.

10.1.3.3 For single-use IPPB equipment at home, the rental/purchase of a 50 psi gas source is usually necessary.

10.1.3.4 Limited research indicates that single-use IPPB may be a safe and effective method of delivering IPPB without the need for conventional IPPB capital equipment.[72]

10.1.4 IPPB circuitry includes large bore and connective tubing, nebulizer, adapters, and patient connection (mouthpiece, lip seal, mask, 15-mm ETT connector), and if needed, nose clips.

10.1.5 Tissues, emesis basin, or sputum cup for collecting or disposing of expectorated sputum

10.1.6 Gloves, gown, goggles, and/or mask with face shield as indicated

10.1.7 Volume measuring device (handheld spirometer or other volume-collecting bag)

10.1.8 Oral and/or endotracheal suction equipment

10.2 Personnel: A continuum 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 after 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, ausculation, and vital-signs determination

10.2.1.8 Ability to implement Standard

Precautions and use proper infection control

10.2.2 Level II Personnel must exhibit all Level I skills and demonstrate:

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 health care 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 equipment

10.2.2.10.3 Cleaning of equipment

10.2.2.10.4 Breathing patterns and coughing 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 Standard 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 Optimal breathing patterns and coughing techniques

10.2.3.6 Technique modification in response to adverse reactions and 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, F_{IO_2}, inspiratory time, expiratory time, plateau pressure, PEEP

11.2 Respiratory rate

11.3 Delivered tidal volume

11.4 Pulse rate and rhythm from ECG if available

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

11.6 Sputum production: quantity, color, consistency

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: Every 1 to 6 hours for IPPB as tolerated. IPPB order should be re-evaluated at least every 24 hours based on assessments during individual treatments.

12.2 Acute/home care patients:

12.2.1 Common strategies for IPPB vary from b.i.d. to q.i.d. 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 Home care patients should be reevaluated/reinstructed periodically and with any change of status.

IPPB 13.0 INFECTION CONTROL:[50]

13.1 Caregivers should implement Standard Precautions[73] and appropriate guidelines for prevention of tuberculosis transmission.[74]

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/IPPB circuits should be changed between patients, when visibly soiled, or according to institutional infection control policy.

13.5 IPPB machines/manifolds can be fitted with a scavenger or filter system to prevent aerosol from being released outside the immediate treatment areas.[75]

13.6 Nebulizers should not be rinsed with tap water between treatments,[76,77] but may be rinsed with sterile water or sterile saline and allowed to air dry.

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