Intrapulmonary Percussion Ventilation

Introduction

IPV is designed to both treat active pulmonary disease and to prevent the development of disease caused by secretion retention. Specific goals of therapy include promoting the mobilization of bronchial secretions, improving the efficiency and distribution of ventilation, providing an alternative delivery system for bronchodilator therapy, providing intrathoracic percussion and vibration, and providing an alternative system for the delivery of positive pressure to the lungs. The Phasitron may be manually triggered during IPV therapy in non-intubated, spontaneously breathing patients or may be set to continuous percussion for use in intubated patients. IPV may be applied via mouthpiece, mask, artificial airway, or through a ventilator.

Audience

A qualified respiratory care practitioner will administer chest physiotherapy to the patient using the Vest

Accountability/Training

- Chest Physiotherapy may be administered by a Licensed Respiratory Care Practitioner trained in the procedure(s).
- Training must be equivalent to the minimal entry level in the Respiratory Care Service with the understanding of age specific requirements of the patient population treated.

Indications

- Mechanically ventilated patients with atelectasis
- Bronchitis and bronchiectasis
- Bronchopneumonia
- Chronic obstructive pulmonary disease
- Cystic fibrosis
- Neuromuscular disorders which produce pulmonary symptoms
- Restrictive lung disease with recurrent atelectasis
- Post thoracic and abdominal surgery
- Patient refractory to traditional bronchial hygiene methods
- Patients with artificial airways who are unable to maintain clear lungs

Contraindi-cations

- Untreated pneumothorax (without chest tube)
- Hemoptysis
- Active tuberculosis

Precautions

- Patient should not receive IPV therapy immediately after eating. A period of at least one hour should be observed after meals before the initiation of therapy to minimize the risk of aspiration.
- Vital signs must be monitored, and the patient must be continuously assessed during IPV therapy. Observe the patient's heart rate, respiratory rate, blood pressure, and pulse oximetry closely for signs of intolerance.

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Precautions Continued

- Tube feeding should be stopped for one hour prior to IPV therapy, and patients should remain at a 45º angle during therapy to minimize the risk of aspiration.
- Supplemental oxygen must be provided for patients requiring it, and the FiO_2 should be monitored.
- Suction equipment should be immediately available at the bedside during IPV therapy in case of airway compromise due to copious secretion mobilization.
- To minimize the risk of barotrauma, a pressure pop off must be utilized when using IPV for mechanically ventilated patients. Monitor peak airway pressures closely.
- Driving pressure of 30-45 psi must be used during IPV to achieve therapeutic effects. Always assess the patient's chest excursion to determine the appropriate driving pressure.
- An IPV treatment should be discontinued if a patient experiences any of the following: increased shortness of breath, chest pain, or an increased FiO_2 requirement evidenced by transcutaneous desaturation, significant changes in heart rate or rhythm, blood pressure, or skin color, marked diaphoresis, fatigue, or emesis. Notify the physician and the RN, and continue to monitor the patient for progression of symptoms. Reevaluate the indications for therapy.
- If a patient experiences difficulty in clearing secretions during therapy, assist the patient as needed with naso/orotracheal suctioning.

Adverse Reactions

An IPV treatment should be discontinued if a patient experiences any of the following:

- Increased shortness of breath, chest pain, or an increased FiO_2 requirement evidenced by transcutaneous desaturation, significant changes in heart rate or rhythm, blood pressure, or skin color, marked diaphoresis, fatigue, or emesis. Notify the physician and the RN, and continue to monitor the patient for progression of symptoms. Reevaluate the indications for therapy.
- If a patient experiences difficulty in clearing secretions during therapy, assist the patient as needed with naso/orotracheal suctioning.

Procedure

Step	Action
1.	Check the physician's order for IPV therapy. An appropriate order includes the frequency of therapy
2.	Assess and document the patient's clinical status: chest radiograph, respiratory rate and pattern, breath sounds, pulse oximetry, heart rate and rhythm, and blood pressure.

Procedure

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Step	Action
3.	Active participation by the patient in the treatment will promote quicker achievement of therapeutic goals, and a more optimal outcome may be achieved.
4.	Assemble the Phasitron and aerosol generator, and connect these to the IPV circuitry. The four tubes of the Tubing Harness are color-coded for easy assembly. Simply match each colored tube with its position on the Breathing Head Assembly (matching color orifice) and then snap the five mm tubing end (Snap Lock Bayonet) onto the orifice. Connect the opposite ends to each of their corresponding color-coded Service Sockets on the front of the IPV unit. Install the red condenser tubing so that one end fits over the red exhalation port of the Phasitron; the other end will remain free. Note that a high volume of condensate may drip from the end of the tubing so that the use of an absorbent cloth may be appropriate to avoid wetting of clothing, bedding, and the floor.
5.	Connect the IPV unit pressure hose to a 50-psi outlet.
6.	Using the source pressure control knob, set the driving pressure to 25 psi: • Turning the control clockwise will show evidence of increasing pressure on the pressure gauge; however, when decreasing the pressure (counterclockwise turn), the decrease in pressure will ***not*** be apparent on the gauge. Decreasing the pressure is best accomplished by pressing the Remote Switch while visualizing the pressure on the gauge. **Note:** This is only a starting driving pressure. The pressure will be increased during therapy to the optimal therapeutic level.
7.	Set the Percussive Rate Control at FULL EASY (fully counterclockwise). This setting corresponds to maximal percussion frequency and minimal Impact Time, and may be the optimal setting for patient initiation. As the patient is acclimated to IPV, the Percussive Rate Control may be rotated clockwise for an increasing Percussive

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Procedure Continued

Step	Action
7	Impact (decreasing percussion frequency). The 12:00 position generally provides for the optimal therapeutic effect.
8.	Instill the medication and diluent into the aerosol generator. Note: The IPV aerosol generator requires a high volume. An accurate dosage must be ensured at a total volume of 20 ml of solution.
9.	Perform a functional check of the IPV unit: • Turn the master control knob to the ON position. • Check that a dense aerosol is being delivered through the outflow port of the patient manifold. • Place the IPV test lung on the outflow port of the patient manifold. • Press the Remote Switch to activate the Phasitron. The unit should be percussing now. • Note: During activation of the Phasitron, the mist will almost disappear due to mixing with the therapeutic gas flow. The dense mist should reappear upon release of the Remote Switch. • Turn the percussion control knob clockwise and observe that the frequency of percussions decreases. • Return the percussion knob to fully counter-clockwise (FULL EASY). **Note:** Should the unit fail any part of this functional check, refer to the Troubleshooting Guide at the end of this procedure, or refer to the Calibration and Programming Guide located with the IPV Operator's Manual and User's Guide.

Initiation of Therapy
Non-Intubated

Step	Action
1	Attach an IPV mouthpiece to the outflow port of the patient manifold. The round rather than the flat mouthpiece should be used whenever possible to provide the optimal treatment.

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Procedure Continued

Step	Action
2	Position the patient comfortably in a chair or in a semi-Fowler's position in the bed. In some patients with regional pulmonary disease, i.e., cystic fibrosis, bronchiectasis, or lobar pneumonia, maximal benefit from IPV may be derived from postural drainage maneuvers during IPV therapy.
3	Instruct the patient to create a tight seal around the mouthpiece while "splinting" the cheeks. Maintenance of taut cheek muscles and oropharynx and prevents "cheek flapping". Note: Patients who cannot maintain a tight mouth seal around the mouthpiece may benefit from the use of a mouthpiece/lip seal or a mask.
4	Instruct the patient to depress the Remote Switch prior to inspiration. The Remote Switch should remain depressed throughout the entire inspiratory cycle. Alternatively, the therapist may control the percussion interval. The percussion interval should minimally last from five to ten seconds to ensure a homogenous gas distribution; however, the interval may be sustained for much longer periods and may be more beneficial if maintained throughout the entire respiratory cycle.
5	Have the patient continue to breathe the aerosol mist during resting (non-percussive) intervals.
6	Assess the patient's chest excursion and breath sounds throughout the treatment. Adjust the driving pressure to that level which produces visible "chest shaking," i.e., percussions are being distributed to the lung periphery. Additionally, the optimal setting of the driving pressure may correspond with improvements in breath sounds in marginally ventilated areas. Rarely is a pressure less then 30 psi sufficient to produce therapeutic effects.
7	Assist the patient as needed to maintain a clear airway with appropriate coughing intervals and suctioning. The Remote Switch should always be released during coughing episodes to avoid air trapping and barotrauma.

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Procedure Continued

Step	Action
8	Terminate therapy after 20 minutes or after the drug has been completely nebulized.
9	Reassess the patient for the efficacy of therapy and for tolerance. A complete post-treatment assessment will include heart rate, blood pressure, respiratory rate and pattern, breath sounds, type and amount of secretions, and transcutaneous oxygen saturation.

Non-Ventilated Patients with Artificial Airways

Step	Action
1	Suction the patient prior to the initiation of therapy.
2	Deflate the cuff of the artificial airway.
3	Connect the 15 mm (internal diameter) port of the Phasitron to the airway. A flexible tubing adapter may be placed between the airway and the Phasitron to relieve some of the stress of the IPV circuitry on the airway.
4	Proceed with the treatment as in steps 2 through 9 above. **Note:** Percussion may be set to continuous if tolerated by the patient. To activate continuous percussion, disconnect the green Remote Switch tubing at the Phasitron.

Intubated, Mechanically Ventilated Patients

Note: Because cycling problems have occurred while interfacing of IPV with microprocessor-driven ventilators, the manufacturer recommends use if IPV during spontaneous breathing modes only including SIMV, Pressure Support, and CPAP

Continuous monitoring of the patient-ventilator system is imperative throughout therapy.

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Step	Action
1	Suction the patient prior to the initiation of therapy. During the course of therapy, frequent suctioning may be required to maintain a good airway due to the mobilization of copious secretions. In some cases, it may be appropriate to deflate the cuff of the patient's airway, based on a careful consideration of the patient's need for stabilizing airway pressure versus the ability to maintain a patent airway in the face of copious secretion mobilization.
2	Attach the appropriate pressure relief valve to the end of the Phasitron. Two valves are available: one is mechanically set to pop-off at 50 cm H_2O (green cap ring) pressure and the other is set at 100 cm H_2O (red cap ring).
3	Insert the IPV circuit assembly into the ventilator circuit. The pop-off unit should be positioned between the patient wye and the inspiratory limb of the circuit.
4	Prior to powering on the IPV unit decrease the patient's delivered tidal volume by a minimum of ten percent. This is necessary to prevent an accumulative volume increase due to percussion delivery during fixed tidal volume delivery. It may be necessary to decrease the tidal volume by as much as 50 percent in some cases. Careful monitoring of the patient's exhaled tidal volumes and peak airway pressures will alert the therapist to the need for further tidal volume reduction.
5	Proceed with the treatment as in steps 2 through 9 above. **Note:** Therapeutic driving pressures for ventilated patients may be typically higher than in non-ventilated patients. Constant assessments of chest excursion and breath sounds are essential to deliver optimal therapy.
6	At the termination of therapy, reinflate the airway cuff and readjust the ventilator to deliver the ordered tidal volume.

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Maintenance

Step	Action
1	To reduce the incidence of pneumonia and other respiratory tract infections: • Discard any remaining contents of solution inside the nebulizer after every treatment • Using a single alcohol swab, wipe the inside of the aerosol generator in between treatments and allow for drying before putting away in patient treatment bag.
2	Disassemble, thoroughly clean and disinfect the circuitry between patient uses. The non-disposable parts may be ethylene oxide sterilized, pasteurized, or autoclaved.
3	Reassemble the circuitry for the next use. Wipe down the surface of the IPV unit with Cavicide prior to storage and when visibly soiled.
4	Lubricate the elastomeric O-rings and the Phasitron diaphragm as needed to maintain smooth seals and proper mating of parts. A silicone based inert lubrication is included in the spare parts kit for this purpose. The kit also includes spare parts of the elastomeric components

Documentation

Document the pre-and post-treatment clinical assessments, sputum production, medication and dosage (including diluent volume and total solution volume), and therapeutic driving pressure on the electronic medication record (MAR) and in Epic per RCS Policies # 7.1.1 and # 7.1.2.

Infection Control

Follow procedures outlined in Healthcare Epidemiology Policies and Procedures #2.24; Respiratory Care Services.
http://www.utmb.edu/policy/hcepidem/search/02-24.pdf

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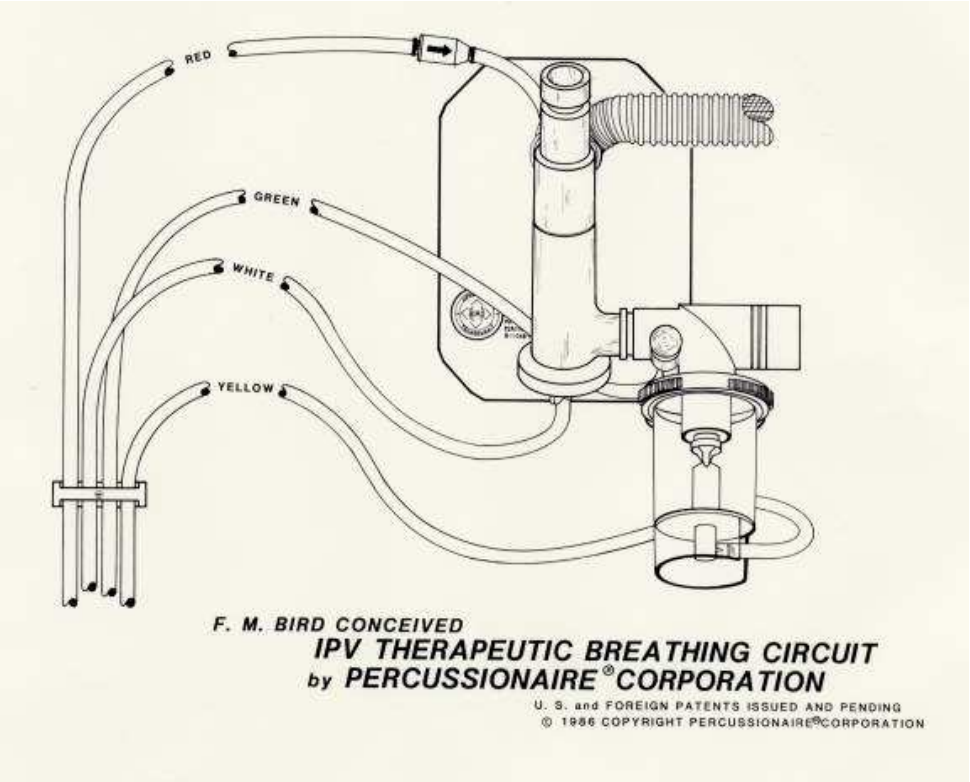
Intrapulmonary Percussive Ventilation Users Guide.