



Critical Care Therapy and Respiratory Care Section

Category:	Clinical
Section:	Bronchial Hygiene
Title:	Chest Physiotherapy
Policy #:	01
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1.0 DESCRIPTION

1.1 Definition

Chest physiotherapy (CPT) is one aspect of bronchial hygiene and may include turning, postural drainage, chest percussion and vibration, and specialized cough techniques known as directed cough. Any or all of these techniques may be performed in conjunction with medicinal aerosol therapy (i.e., bronchodilators or mucolytics). The goals of CPT are to move bronchial secretions to the central airways via gravity, external manipulation of the chest, and to eliminate secretions by cough or aspiration with a catheter. Improved mobilization of bronchial secretions contributes to improved ventilation-perfusion matching and the normalization of the functional residual capacity.

NOTE: CPT will not be done if IPV is ordered.

- 1.1.1 Turning is the rotation of the body about its long axis. This is usually done in conjunction with procedures designed to aid patient comfort and skin care. However, attention to chest position and deliberate region-specific positioning is usually needed to effect secretion mobilization. Special beds which periodically impose a programmable position change provide an adjunct to manual turning of the patient.
- 1.1.2 Postural drainage is the positioning of the patient and bed in such a way as to have the carina inferior to a lung segment to be drained. The targeted lung segment is as nearly perpendicular to the ground as possible. The aim is to move secretions from peripheral to more central airways for elimination. The duration is usually 3 to 15 minutes per segment depending on the properties of the secretions.
- 1.1.3 Percussion may also be referred to as cupping or clapping. These names describe the manual rhythmic striking of the thorax over a

lung segment which is being drained. The theory is that this energy is transmitted through the chest wall to the lung and is able to dislodge secretions adhering to lung tissue. Mechanical and pneumatic devices which mimic this action are available. This action may also be used to initiate a cough by percussing over the large airways.

- 1.1.4 Vibration is the placement of hands along the ribs in the direction of expiratory movement of the chest. A small rapid vibration (tremor) and slight pressure is applied during exhalation to accentuate this phase of the respiratory cycle. The maneuver mimics the forced exhalation of a cough. A vigorous form of this manual vibration combined with positive pressure ventilation is called an "artificial cough". This is used as an assist technique for sputum removal in paralyzed patients on ventilators. Mechanical devices used to perform vibration differ from the manual method in that the mechanical device is continuously applied during both inspiration and exhalation.
- 1.1.5 When the spontaneous cough is inadequate to mobilize secretions, directed cough techniques may be employed. Directed cough techniques are deliberate maneuvers that are taught, supervised, and monitored. The Forced Expiratory Technique, or "huff cough," and manually assisted cough are two such maneuvers. Refer to the AARC Clinical Practice Guideline "Directed Cough" for further instruction regarding these techniques.

1.2 Indications

The following are general indications which suggest the need to evaluate a patient for the appropriateness of CPT. Following these is a list of technique-specific indications.

- 1.2.1 Excessive sputum production
- 1.2.2 Reduced effectiveness of cough
- 1.2.3 History of success in treating a pulmonary problem with CPT
- 1.2.4 Adventitious breath sounds suggestive of secretions in the airways which persist after coughing
- 1.2.5 Change in vital signs
- 1.2.6 Abnormal chest radiograph suggesting atelectasis, mucus plugging, or infiltrates

- 1.2.7 Significant deterioration in the indices of gas exchange from baseline status
- 1.2.8 Turning
 - 1.2.8.1 Inability or reluctance of patient to change body position
 - 1.2.8.2 Poor oxygenation associated with position, i.e. unilateral lung disease
 - 1.2.8.3 Potential or actual atelectasis
 - 1.2.8.4 Presence of an artificial airway
- 1.2.9 Postural Drainage
 - 1.2.9.1 Evidence or suggestion of difficulty with secretion clearance
 - 1.2.9.2 Adult having difficulty expectorating sputum volume greater than approximately 25 ml/day
 - 1.2.9.3 Evidence or suggestion of retained secretions in a patient with an artificial airway
 - 1.2.9.4 Presence of atelectasis caused by or suspected of being caused by mucus plugging
 - 1.2.9.5 Diagnosis of a disease with altered rheology such as cystic fibrosis, bronchiectasis, or cavitory lung disease
 - 1.2.9.6 Presence of a foreign body in the airway
- 1.2.10 Percussion/Vibration
 - 1.2.10.1 Sputum volume or consistency suggesting a need for additional manipulation (percussion and/or vibration) to assist movement of sputum in a patient receiving postural drainage
- 1.2.11 Directed Cough
 - 1.2.11.1 Atelectasis
 - 1.2.11.2 Postoperative prophylaxis against retained secretions for patients with an ineffective spontaneous cough
 - 1.2.11.3 As a routine part of bronchial hygiene in patients with cystic fibrosis, bronchiectasis, chronic bronchitis, necrotizing pulmonary infection, spinal cord injury, or ineffective spontaneous cough
- 1.3 Contraindications: The decision to intensify the patient's bronchial hygiene program by initiating CPT requires a careful assessment of the risks versus the benefits of intervention. Therapy must be modified according to the patient's needs, tolerance, condition, and therapeutic goals, and assessment must be ongoing through each subsequent therapy session. Therapy is modified to improve results while minimizing risk, pain and discomfort. Continual assessment and modification of therapy render most

contraindications as relative with the exception of those absolute contraindication noted below.

- 1.3.1 Positioning
 - 1.3.1.1 **Absolute:** Unstabilized head and/or neck injury
 - 1.3.1.2 **Absolute:** Active hemorrhage with hemodynamic instability or significant possibility of occurrence
 - 1.3.1.3 Intracranial pressure (ICP) greater than 20 mm Hg
 - 1.3.1.4 Recent spinal surgery (i.e., laminectomy)
 - 1.3.1.5 Acute spinal injury
 - 1.3.1.6 Active hemoptysis
 - 1.3.1.7 Empyema
 - 1.3.1.8 Bronchopleural fistula
 - 1.3.1.9 Cardiogenic pulmonary edema
 - 1.3.1.10 Large pleural effusion
 - 1.3.1.11 Pulmonary embolism
 - 1.3.1.12 Confused, anxious, or otherwise impaired patients who actively resist or do not tolerate position changes
 - 1.3.1.13 Rib fracture with or without flail chest or other significant chest injury
 - 1.3.1.14 Surgical wound or healing tissue

- 1.3.2 Trendelenburg Position
 - 1.3.2.1 ICP greater than 20 mm Hg
 - 1.3.2.2 Conditions in which increases in ICP must be avoided (i.e., neurosurgery, aneurysms, and eye surgery)
 - 1.3.2.3 Uncontrolled hypertension
 - 1.3.2.4 Abdominal distension which compromises patient comfort or clinical status
 - 1.3.2.5 Esophageal or other upper body surgery adversely affected by this position
 - 1.3.2.6 Lung carcinoma recently treated by surgery or radiation with actual or significant potential of hemoptysis
 - 1.3.2.7 Uncontrolled airway with significant risk of aspiration (tube feeding or recent meal)

- 1.3.3 Reverse Trendelenberg Position
 - 1.3.3.1 Hypotension
 - 1.3.3.2 History of orthostatic hypotension
 - 1.3.3.3 Vasoactive drug administration

- 1.3.4 Percussion and/or Vibration
 - 1.3.4.1 Subcutaneous emphysema
 - 1.3.4.2 Recent epidural anesthesia or recent epidural or intrathecal drug administration
 - 1.3.4.3 Recent skin grafts or flaps on the thorax

- 1.3.4.4 Burns, open wounds, and skin infections of the thorax
 - 1.3.4.5 Recently placed transvenous or subcutaneous pacemaker (mechanical vibration and percussion are relatively more contraindicated)
 - 1.3.4.6 Suspected or known active pulmonary tuberculosis
 - 1.3.4.7 Lung contusion
 - 1.3.4.8 Worsening bronchospasm
 - 1.3.4.9 Osteomyelitis of the thorax
 - 1.3.4.10 Osteoporosis of the thoracolumbar region
 - 1.3.4.11 Coagulopathy or thrombocytopenia (manual vibration may be well tolerated)
 - 1.3.4.12 Complaints of chest wall pain
 - 1.3.4.13 **Absolute:** Osteogenesis imperfecta or other bone disease associated with brittle or extremely fragile bones
- 1.3.5 Directed Cough
- 1.3.5.1 **Absolute:** Inability to control possible transmission of infection from patients suspected or known to have pulmonary tuberculosis
 - 1.3.5.2 Elevated intracranial pressure or known intracranial aneurysm
 - 1.3.5.3 Acute unstable head, neck or spine injury
 - 1.3.5.4 Reduced coronary artery perfusion, as in acute myocardial infarction
 - 1.3.5.5 Unconscious patient with unprotected airway
 - 1.3.5.6 Acute abdomen (i.e., abdominal aortic aneurysm, hiatal hernia, or pregnancy)
 - 1.3.5.7 Untreated pneumothorax of flail chest
 - 1.3.5.8 Osteoporosis of the thoracolumbar region
 - 1.3.5.9 Coagulopathy or thrombocytopenia

1.4 Precautions

- 1.4.1 Application of the various techniques of chest physiotherapy may pose risks to some patients (See 1.5 Adverse Reactions and Interventions). Appropriate precautions include the immediate availability of functional suction equipment, emergency airway equipment, and oxygen therapy equipment which allows for upward adjustment in the delivered FiO₂. Patients should also be monitored throughout therapy for changes in the respiratory pattern, work of breathing, pulse, and skin color.
- 1.4.2 Adrenergic bronchodilators in solution and metered dose inhalers should be available in case of significant bronchospasm during treatment.

- 1.4.3 Instruction in proper cough technique prior to therapy may decrease the risk of decompensation in case of pulmonary hemorrhage or mobilization of copious secretions.
- 1.4.4 Because the optimal positioning of patients in the intensive care unit may be difficult (due to invasive and other apparatus) and treatment times may be compromised due to patient tolerance or the urgency of other care interventions, the effectiveness of CPT may also be compromised.
- 1.4.5 The absence of an acceptable cough may render application of CPT less effective. Diligence in coaching the patient to an effective cough as well as timely suctioning of the trachea are essential to performing good CPT.

1.5 Adverse Reactions and Interventions

- 1.5.1 Hypoxemia: Administer higher concentrations of oxygen before and during therapy if the patient has a potential or history of falling arterial oxygen saturation. Increase the oxygen concentration if vigorous, paroxysmal, or violent coughing is precipitated. If increases in oxygen concentrations fail to prevent or correct hypoxemia, administer maximal oxygen (100% if possible), discontinue the therapy, return the patient to an appropriate rest position (usually the one prior to therapy), ensure adequate ventilation, and notify the physician and nurse. Hypoxemia during CPT may be avoided by judicious modification of therapy so that ventilation-perfusion relationships are not worsened. In unilateral lung disease, for example, avoid positioning the affected side down or do so for the absolute minimum time needed to accomplish the therapeutic goal.
- 1.5.2 Increases in Intracranial Pressure: Patients at risk for neurological status changes (i.e., patients with clotting or bleeding abnormalities) must be closely monitored. Assess the patient frequently for his/her tolerance of the therapy, especially for acute onset or worsening headache. Monitor closely for changes in vital signs and other indicators of neurologic status (i.e., alertness and orientation). If changes occur, discontinue the therapy, return the patient to an appropriate rest position (usually the one prior to therapy), ensure adequate ventilation, and notify the nurse. Consult the physician regarding a reassessment of the risks to the patient versus the benefits of therapy.
- 1.5.3 Acute hypotension during therapy: An acute fall in the blood pressure must be heeded by a return of the patient to an appropriate

rest position (usually the one prior to therapy). Ensure adequate ventilation, consult the physician, and notify the nurse. Be prepared to place the patient in the Trendelenberg position if his/her condition warrants it.

- 1.5.4 Pulmonary Hemorrhage: In the event that hemoptysis ensues, stop the therapy immediately, return the patient to an appropriate rest position (usually the one prior to the therapy), and assist the patient as needed to maintain a proper airway and adequate ventilation. Notify the physician and nurse of the urgency of the situation and remain with the patient until the physician responds.
- 1.5.5 Pain or Injury to Muscles, Ribs or Spine: Coordination of CPT with pain medication administration may serve to lessen the pain in patients. Assure the patient that you will not exceed his/her pain threshold. Modify techniques according to the patient's tolerance of the procedure. When discomfort becomes acute and is directly associated with the therapy, stop the treatment. Consult with the physician and nurse regarding a plan to minimize risks to the patient while optimizing achievement of the goals of therapy.
- 1.5.6 Vomiting and/or Aspiration: The Trendelenberg position is contraindicated in patients clearly at risk of aspiration. Prior to starting therapy, be sure that the patient is not experiencing nausea and has not just eaten. Tube feeding should be discontinued a minimum of 15 minutes prior to beginning a CPT session. In the event of airway compromise, discontinue the therapy, and assist the patient to maintain an open airway via suctioning maneuvers as needed. Place the patient in an upright position, and administer oxygen as indicated. Consult with the physician and nurse regarding a plan to minimize the risks of therapy while optimizing achievement of the goals of therapy.
- 1.5.7 Bronchospasm: CPT is contraindicated in acute asthma. Significant cough-induced bronchospasm should be attended by a return of the patient to an appropriate rest position (usually the one prior to therapy), oxygen administration as needed, and a consultation with the physician regarding the need to administer bronchodilators.
- 1.5.8 Dysrhythmias: Dysrhythmias associated with CPT must be judged for clinical severity and cause. A baseline dysrhythmia does not preclude CPT. Attempts to prevent it by modifying therapy should be tried. If a significant dysrhythmia develops, administer maximal oxygen (100% if possible), stop the therapy, return the patient to an appropriate rest position (Usually the one prior to

therapy), and notify the physician and nurse immediately. If dysrhythmia is life-threatening, activate the emergency response team and begin CPR. Do not leave the patient until the situation is stabilized.

- 1.5.9 Excessive Lung Volume During Mechanical Ventilation: Dramatic increases in lung volumes are a real possibility with CPT. Ventilatory parameters should be monitored throughout therapy to ensure the appropriateness of mechanical ventilator settings. **Patients placed in the pressure control mode are particularly at risk for serious lung injury if sudden removal of secretions leads to dangerously high tidal volumes.** Should the patient's volumes become consistently greater than 12 ml/kg of body weight, return the patient to an appropriate rest position (usually the one prior to therapy), and reevaluate the tidal volume. The persistence of a high tidal volume warrants a decrease in inspiratory pressure to return tidal volumes to less than 12 ml/kg of body weight. Consult with the physician regarding further need for adjustment of the ventilator parameters.

1.6 Assessment of Outcome: The following criteria support the continuation of therapy.

- 1.6.1 Change in Sputum Production: An adequate level of hydration is necessary to properly assess the volume of sputum and ease of expectoration. For patients who produce less than 25 ml of sputum per day, and who are adequately hydrated, CPT is not indicated. Also, in patients for whom an increase in the amount of expectorated sputum is not realized after the initiation of CPT, therapy should be discontinued.
- 1.6.2 Change in Breath Sounds: Initially only assisted cough methods should be used to evaluate change if breath sounds greater than that observed with assisted cough alone. Breath sounds should be evaluated over several hours. Movement of sputum to more central airways may be construed as clinical deterioration because adventitious breath sounds may become louder, more numerous, lower-pitched, or otherwise "worse." however, effective expectoration may not occur until well after the end of the CPT session.
- 1.6.3 Subjective Change Reported by Patient: The clinician should ask the patient how he/she feels before, during, and after therapy. Feelings of pain, dyspnea, syncope, nausea, or other discomfort must be considered in deciding whether to modify or discontinue therapy. Easier clearance of secretions and increased volume of

secretions during or after treatment support continuation of therapy.

- 1.6.4 Improved Quality of Sleep: Subjective or apparent improvement in the quality of sleep attributable to effective secretion clearance may result from CPT. This supports continuation of therapy.
- 1.6.5 Change in Vital Signs: Any change in vital signs must be investigated and its cause and severity determined. One common reason for a deterioration in vital signs is patient fatigue. Significant changes in vital signs are an indication to curtail CPT activities. The clinician should anticipate the patient becoming fatigued, and have the patient conserve enough energy to be able to cough effectively or to tolerate suction of the trachea.
- 1.6.6 Change in the Chest Radiograph: Resolution or improvement of a patient's chest film suggest the need for a reevaluation therapy.
- 1.6.7 Change in Gas Exchange: Significant improvement of a patient's blood gas status or oxygen saturation suggests the need for a reevaluation of therapy.
- 1.6.8 Change in Lung Mechanics: Patients who are monitored for lung mechanics or are mechanically ventilated may be evaluated for changes in resistance and/or compliance. Changes consistent with resolution of atelectasis and mucus plugging, i.e. decreased resistance and increased compliance, may necessitate a discontinuation of therapy.

2.0 EQUIPMENT

- 2.1 A bed capable of Trendelenberg and reverse Trendelenberg positions
- 2.2 Pillows for position and/or cough support and patient comfort
- 2.3 Patient gown or light towel to cover percussed area
- 2.4 Tissues and/or basin for sputum disposal
- 2.5 Functioning suction equipment including a Yankauer suction catheter
- 2.6 Optional mechanical assist devices, i.e. mechanical percussor or plastic percussion cups
- 2.7 Stethoscope

- 2.8 Cardiopulmonary monitor
- 2.9 Pulse oximeter
- 2.10 Emergency airway equipment including manual resuscitator
- 2.11 Universal precautions attire
- 2.12 Most recent chest radiograph

3.0 PROCEDURE

- 3.1 Assess the patient's chest radiograph for pulmonary findings and assess the indications for bronchial hygiene therapy and chest physiotherapy for the patient. Determine which regions of the lung require attention.
- 3.2 Prior to implementing CPT procedure, assess the patient for respiratory rate and work of breathing, heart rate and rhythm, skin color, blood pressure, pulse oximetry, and breath sounds. Interview the patient if possible as to subjective feelings of cough effectiveness and the ability to mobilize secretions, and breathing difficulty (i.e., the ability to take a deep breath or the existence of exertional dyspnea).
- 3.3 Perform CPT techniques appropriate for the patient.
- 3.4 Monitor the following throughout the therapy session and immediately following therapy:
 - the patient's reaction to the therapy including subjective responses to pain
 - discomfort and dyspnea
 - heart rate and rhythm
 - respiratory rate and pattern including work of breathing
 - cough and sputum production including color, quantity, consistency, and odor
 - breath sounds
 - skin color
 - mental status
 - oxygen saturation by pulse oximeter
 - blood pressure
 - use of splinting, external cough supports, or special cough techniques
For specific instruction on special cough techniques, refer to the AARC Clinical Practice Guideline "Directed Cough"
- 3.5 Modify the techniques of CPT according to patient tolerance, and assist with sputum clearance as needed.

- 3.6 The frequency of therapy sessions is determined by a good assessment of the patient's clinical status and the indications for therapy as described in 3.1 and 3.2 above, and according to the following guidelines:
- 3.6.1 Turning: Mechanically ventilated patients should be turned at least once every two hours as tolerated. Confer with the nurse to optimize a turning schedule.
 - 3.6.2 Postural Drainage: During the acute phase of a pulmonary process, perform therapy at least every four hours. Daily reevaluation should be performed and the frequency reduced as soon as the indications for therapy show improvement, see Section 1.2.
 - 3.6.3 Percussion/Vibration: Perform as needed in conjunction with postural drainage. Discontinue when reevaluation reveals that postural drainage alone is sufficient.
 - 3.6.4 Directed Cough: Perform as often as needed to prevent atelectasis and secretion retention, and before and after other CPT procedures.
- 3.7 Ensure patient comfort and safety prior to leaving the bedside.

4.0 POST PROCEDURE

- 4.1 Chart the procedure in the "Comments" section of the "Continuous Ventilation Record". Include all pertinent information as described in 3.2 and 3.4 above, and record the lung regions drained/percussed, the response to therapy, and adverse reactions.
- 4.2 Report all significant findings to the nurse and physician caring for the patient.
- 4.3 Disinfect all nondisposable equipment used and store appropriately.

5.0 REFERENCES

- 5.1 AARC Clinical Practice Guideline "Postural Drainage Therapy"
- 5.2 AARC Clinical Practice Guideline "Directed Cough"

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