

LUNG EXPANSION THERAPY

INTRODUCTION

- Pulmonary complications are the most common serious problems seen in patients who have undergone thoracic or abdominal surgery
- They include
 - atelectasis
 - pneumonia
 - acute resp failure

ATELACTASIS

- Absence of gas from a part or whole of lung due to failure of expansion or resorption of the gas from the alveoli

TYPES

- Resorption atelectasis
- Passive atelectasis
- Lobar atelectasis

CLINICAL SIGNS OF ATELECTASIS

- Increased resp rate
- Fine late insp crackles over affected region
- Bronchial type breath sounds
- Tachycardia

LUNG EXPANSION THERAPY

- Includes a variety of respiratory care modalities to prevent or correct atelectasis

- ## TYPES

- Incentive spirometry
- Intermittent positive pressure breathing
- Continuous positive airway pressure
- Positive expiratory pressure

INDICATIONS

- Post operative patients especially after thoracic & upper abdominal surgery
- Neuromuscular disorders

MECHANISM

- Increase in transpulmonary pressure
- $P(L) = P(\text{alv}) - P(\text{pl})$
- Can be done by either by
 - Decreasing the pleural pressure by
 - spontaneous deep inspiration
 - Or increasing alveolar pressure by
 - application of positive pressure

INCENTIVE SPIROMETRY (IS)

- Designed to mimic natural sighing by encouraging patients to take deep slow breaths
- Sustained Maximal Inspiration is a slow, deep inhalation from the FRC upto the total lung capacity followed by 5 to 10 sec breath hold

INDICATIONS

- Presence of conditions predisposing to development of atelectasis
- Atelectasis
- Presence of restrictive lung defects associated with quadriplegia &/or dysfunctional diaphragm

CONTRAINDICATIONS

- Uncooperative patient
- Unable to take deep breaths effectively i.e. VC<10 ml/kg
- Cannot be instructed or supervised

EQUIPMENT

- Volume oriented :measure volume achieved during SMI
- Flow oriented :measure degree of inspiratory flow
- Successful implementation involves
 - Planning
 - Implementation
 - Follow up

- **PLANNING** :Preop PFT for baseline
- **IMPLEMENTATION** :Effective patient education for correct technique
- Started initially at 5-10 SMI maneuvers/hour

MONITORING

- Frequency of sessions
- No of breaths/session
- Volume/flow goals
- Breath hold maintained
- Vital signs/breath sounds
- New & increasing insp vol each day

POTENTIAL OUTCOMES

Absence/improvement in phy signs

- Decreased resp rate
- Normal pulse rate
- Resolution of abnormal breath sounds
- Normal/improved chest x-ray
- Increased PaO₂ & decreased Pa CO₂
- Increased Sp O₂
- Increased VC & peak exp flows
- Increased FVC

HAZARDS & COMPLICATIONS

- Ineffective unless correctly performed
- Hyperventilation
- Increased bronchospasm
- Fatigue
- Discomfort
- Inappropriate for major collapse

INTERMITTENT POSITIVE PRESSURE BREATHING (IPPB)

- Application of positive pressure to a spontaneously breathing patient as an intermittent or short term therapeutic modality
- Positive pressure at the air way opening creates the needed pressure gradient to cause gas flow into the lung.
- Positive pressure is transmitted from the alveoli to the pleural space during the insp phase of an IPPB treatment causing P_{pl} to rise during inspiration

INDICATIONS

- Pulmonary atelectasis unresponsive to IS or uncooperative patient
- As a short term non invasive ventilatory support for hypercapnic patients

CONTRAINDICATIONS

- Tension pneumothorax
- ICP >15 mm Hg
- Hemodynamic instability
- Active hemoptysis
- Tracheo oesophageal fistula
- Recent esophageal surgery
- Active untreated T B
- Radiographic evidence of blebs
- Recent facial/oral surgery

ADMINISTERING IPPB

- **PLANNING** :To correctly assess the need for IPPB
- **BASELINE ASSESSMENT**
- **General assessment** :vital signs, patient appearance & sensorium, breathing pattern
- **Respiratory system exam**

IMPLEMENTATION

- Proper infection control measures
- Equipment preparation including calibration & checking for leaks in system
- Patient education

APPLICATION

- Device should be properly fitted over patient face
- A sensitivity or trigger level of 1 to 2 cm H₂O is adequate for most patients
- Initial system pressure is set between 10 cm to 15 cm H₂O
- Goal is to establish a breathing pattern of 6 breaths/min with I/E ratio of 1:3 to 1:4

MONITORING

- MACHINE PERFORMANCE
 - sensitivity
 - peak pressure
 - flow setting
 - $F_i O_2$
 - I/E ratio

PATIENT RESPONSE

- Resp rate & expired volume
- Peak flow
- Pulse rate & rhythm
- Mental function
- Skin color
- Breath sounds
- Blood pressure
- Chest x ray
- SpO₂
- Subjective response

POTENTIAL OUTCOMES

- Improved VC
- Increased FEV1
- Enhanced secretion clearance
- Improved chest x ray
- Improved oxygenation
- Favorable subjective response
- Improved breath sounds

HAZARDS & COMPLICATIONS

- Pulmonary barotrauma
- Nosocomial infection
- Respiratory alkalosis
- Gastric distension
- Impaired venous return
- Increased airway resistance
- Dependence

POSITIVE AIRWAY PRESSURE THERAPY (PAP)

- PEP both create exp positive pressure
- EPAP only
- CPAP : maintains positive airway
- pressure throughout resp cycle

MECHANISM

- Exact mech unknown
- Recruitment of collapsed alveoli
- Decreased work of breathing
- Improved distribution of ventilation through collateral channels
- Improved secretion removal

CONTRAINDICATIONS

- Hemodynamically unstable patient
- Facial trauma
- Pneumothorax
- Increased ICP

HAZARADS & COMPLICATIONS

- Hypoventilation
- System leaks
- Pain & irritation
- Barotrauma
- Gastric insufflation & aspiration of gastric contents

SELECTING AN APPROACH

- Patient meets criteria
- YES
- Patient alert NO IPPB
- YES
- VC > 15 ml /kg NO IPPB
- YES
- Excessive secretions YES PEP & B
dilators
- NO
- Goal oriented IS

All the best...