Aerosol Therapy

• Stability: the tendency for aerosol particles to remain in __________________
  – Size: the _______ the particle, the greater the tendency toward stability – the _______ the particle, the greater the tendency to fall out of suspension
  – Concentration: the greater the concentration of particles, the greater the tendency for individual particles to _______ into larger particles and fall out of suspension
  – Humidity: the greater the relative humidity, the greater the stability of the aerosol

Aerosol Therapy

• Penetration and Deposition
  – Penetration refers to the _______ within the respiratory tract that an aerosol reaches
  – Deposition is the _______ of aerosol particles within the respiratory tract
  – Depth of penetration and volume of deposition depend on:
    1. _______ decreases penetration and increases premature deposition but has minimal effect on particles in the therapeutic range of _____ - ____ microns
Aerosol Therapy

Depth of penetration and volume of deposition depend on:

2. _______________ – the greater the kinetic energy of the gas carrying the particles, the greater the tendency for premature deposition

3. _______________ – deposition of particles is increased at any point of directional change or increase airway resistance – the smaller the airway, the greater the tendency for deposition

4. _______________ of the aerosol – chemical composition, size, temperature and other factors affect penetration and deposition

5. Patient's _______________ pattern – has tremendous effect on penetration and deposition

• Optimal Ventilatory Pattern
  - Ventilatory pattern is the _______________ variable that can be controlled to endure maximal penetration and deposition
  - Ideal ventilatory pattern is a large, slowly inspired tidal volume (____-____ x normal volume over ____ seconds)
  - Patient's mouth should be _______________ to help decrease aerosol deposition in the mouth and oropharynx
  - A ____-____ second inspiratory hold helps ensure maximal deposition
Aerosol Therapy

• Optimal Ventilatory Pattern
  – Exhalation should be _____________ and normal
  – Coughing should be encouraged if mobilization of secretions occurs during or at the end of treatment

• Aerosol Clearance – particles are removed from the respiratory tract by three mechanisms
  – __________________ the normal and primary mechanism – moves about _____ ml of secretions to the oropharynx per day
  – Normal ___________ – patients may need instruction on proper and effective coughing techniques
  – __________________ by type III alveolar cells

• Indications for Aerosol Therapy
  – Retained secretions
    • As mentioned, the mucociliary escalator (blanket) normally moves secretions up to the oropharynx
    • The mucus is propelled upward by ciliary motion and moves at a rate of ___-___ cm/min
    • Ciliary motion appears to be affected by numerous factors e.g. tracheal foreign bodies, high FIO2s, positive pressure ventilation, smoke and fumes and pneumonitis of any cause
Aerosol Therapy
– Retained secretions
  • A normal ________ reflex and mechanism also helps clear the lungs, so anything that interferes with these may also lead to retained secretions e.g. surgery, artificial airways, pleural infection/pain
  – Patients should be encouraged to cough and instructed if the cough is ineffective
    » Deep breath
    » Valsalva’s maneuver
    » Forceful expulsion of air

Potential Results of Retained Secretions
1. Inflammation & Partial Plugging
   - Increased $R_{aw}$
   - Uneven Distribution of Ventilation
   - Venous Admixture
   - Hypoxemia
2. Total Plugging
   - Absorption Atelectasis
   - Decreased Lung Compliance
3. Stasis Pneumonia
   - Fever

Aerosol Therapy
– Retained Secretions
  • Common causes
    – __________ – decreased amounts of water in the respiratory tract leads to thicker secretions that are difficult to move
    – Acute __________ – most cause an increase in the production of secretions
    – Tracheal __________ – cause a decrease in ciliary action
    – __________ /limitations – e.g. neuromuscular diseases, surgery
Aerosol Therapy

- Asthma & other reactive airway diseases
  - Bland aerosol therapy may help to decrease ____________
  - Medicated aerosol therapy to help reverse ____________
- Bronchitis/emphysema
  - Both cause ____________ to the airways and an increase in the ____________ of thick secretions
- Cystic fibrosis
  - Aerosol therapy will help to ______ secretions and improve ____________

Aerosol Therapy

- Laryngitis/tracheitis/croup – aerosols, particularly cool aerosols, may help to decrease ____________
- Bronchiectasis – aerosol may help to ____________ secretions
- Smoke/chemical fume inhalation – to relieve ____________
- Physical trauma to the upper airway – to relieve ____________
- Post-extubation therapy to prevent or treat laryngeal ____________
- Aerosol may also be used for sputum induction

Aerosol Therapy

- General Goals of Aerosol Therapy
  - Improve bronchial hygiene
    - Hydrate dried retained ____________
    - Improve efficiency of the ____________ mechanism
  - Restore and maintain normal function of the mucociliary escalator
  - Humidify gases delivered to patients with ____________ airways
  - Deliver ____________
Aerosol Therapy

- Two types of aerosol therapy
  - ___________ aerosol therapy involves the delivery of sterile water or hypotonic, isotonic or hypertonic saline aerosols. Bland aerosol administration may be accompanied by oxygen therapy (CPG excerpt - Scanlon, p. 674)
  - ___________ aerosol therapy involves the delivery of drugs to the airways. May also be accompanied by oxygen therapy

Aerosol Therapy

- Bland aerosol with saline solutions
  - Tonicity is the relative degree of osmotic pressure exerted by a solution. Solutions with a tonicity equal to body fluids are ___________, those with a tonicity less than that of body fluids are ___________ and those with a tonicity greater than body fluids are ___________.
  - Average body cellular fluid has a tonicity equal to a ___________% solution of NaCl (physiologic saline or normal saline)

Na⁺ is sodium (from the Latin natrium)
Cl⁻ is chloride

NaCl is salt. Notice that when the positive ion Na⁺ is combined with the negative ion Cl⁻ the electrical charge of the resulting solution is neutral.
Aerosol Therapy

- So, solutions with a NaCl content of 0.9% are isotonic, solutions with a NaCl content less than 0.9% are hypotonic and solutions with a NaCl content greater than 0.9% are hypertonic
- Administration of isotonic saline (normal saline) usually causes no net change in cellular water content
- Hypertonic saline "__________" water out of cells
- Hypotonic saline usually causes water to be _______________ from the solution into the cells

Aerosol Therapy

- Hazards of Aerosol Therapy
  - Precipitation of _______________
    - Most common in asthmatic patients
    - May follow the administration of certain drugs
    - May result in hypoxemia
  - Increased _______________
    - Because of swelling of dried retained secretions
      - Most often a problem with USN
      - Seen primarily in debilitated patients
      - May result in hypoxemia

Aerosol Therapy

- Systemic fluid _______________
  - Primarily a problem with neonates and children
  - Usually seen with USNs
  - _______________ Can be fairly well prevented with good hand-washing