1. humidification & inhalational therapy

- normally the upper airway warms, moistens & filters inspired gas
- when nasopharynx is bypassed by endotracheal intubation, artificial humidification of inspired gases must be provided

2. general

- the amount of water vapour in a gas may be expressed as:
  (i) absolute humidity (g/m³)
  (ii) relative humidity (RH)
  (iii) partial pressure

3. physical principles

4. clinical applications of humidification

- humidification is required by adverse effects from lack of humidification caused by bypassing the upper airway including:
  (i) increased mucous viscosity
  (ii) depressed ciliary function
  (iii) cytological damage to the tracheobronchial epithelium including mucosal ulceration, tracheal inflammation & necrotising tracheobronchitis
  (iv) microatelectasis from obstruction of the small airways
  (v) airway obstruction due to tenacious or inspissated sputum

5. heat exchange:

- humidification of gases reduces the fall in body temperature associated with anaesthesia and surgery. In this setting, active humidification provides no benefit over heat & moisture exchangers

6. ideal humidification:

- basic requirements of a humidifier should include:
  (i) inspired gas delivered to the trachea at 32-36 degrees with a water content of 30-43g/m³
  (ii) set temperature remains constant and does not fluctuate
  (iii) humidification and temperature remain unaffected by a large range of fresh gas flows
  (iv) the device is simple to use and service
  (v) humidification can be provided for air, oxygen or any mixture of gases
  (vi) the humidifier can be used with spontaneous or controlled ventilation
  (vii) the resistance, compliance & dead space characteristics do not adversely affect spontaneous breathing modes
  (viii) sterility of the gas is not compromised

methods & devices

1. water baths:
   - inspired gas is passed over or through a water bath to achieve humidification
2. cold water humidifiers:
   - the units are simple & inexpensive but at inefficient & provide a potential source of microbiological contamination
3. hot water humidifiers:
   - inspired gas is passed over (ie blow-by humidifier such as Fisher-Paykel) or though (ie bubble or cascade humidifier such as Bennett Cascade) a heated water reservoir
   - water bath is thermostatically controlled (eg 45-60 degrees) to compensate for cooling along the inspiratory tubing; a heated wire may be sited in the inspiratory tubing to maintain a preset gas temperature & humidity
4. heat & moisture exchangers:
   - work on the principle of heat and moisture conservation during expiration allowing inspired gas to be heated and humidified
   - HMEs may be hydropholic or hygroscopic and may also act as a microbial filter
   - HMEs have not been shown to reduce nosocomial pneumonia
   - modern HMEs are light with a small dead space
   - hygroscopic HMEs absorb moisture onto a paper-like material that is chemically coated and this tends to increase their efficiency compared to hydrophobic HMEs
   - HMEs cannot match humidification offered by hot water bath humidifiers which remain the gold standard, particularly if secretions are thick or bloody or minute ventilation is high

1. inadequate humidification
2. overhumidification
3. imposed work of breathing
4. infection
5. electrical hazards

complications of humidification

1. humidification
2. bronchodilator therapy
3. delivery of antimicrobials
4. sputum induction
5. surfactant therapy

clinical applications of inhaled therapy

methods of delivery:
- therapeutic aerosols may be delivered by nebulised (jet or ultrasonic), metered dose inhaler or dry particle inhaler

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general:
- therapeutic aerosols are particles suspended in gas that are inhaled and deposited within the respiratory tract. Numerous factors including particle size, interia and physical nature, gravity, volume & pattern of ventilation, temperature & humidity, airway geometry, lung disease and the delivery system alter aerosol deposition in the airways

clinical applications of inhaled therapy

1. humidiﬁcation
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