Al Mustaqbal University

College of Health and Medical Techniques

Department of Anesthesia

Practical Anesthetic Equipment

Stage Three

Course 1 Lecture 5

Humidifier & Nebulizer

By Lectures

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BSc. Anesthesia & Intensive Care

2025 – 2026

Humidifier

Dry oxygen therapy (without humidification) for a prolonged period is harmful, as it may cause certain problems in patients, including heat loss, dry mucosa, thick secretions, and airway obstruction. This increases the patient's susceptibility to respiratory tract infection. In asthmatic patients, hyperventilation of dry oxygen can lead to bronchoconstriction. Humidification is always recommended wherever oxygen is being delivered for a longer time.

Characteristics of the ideal humidifier

- Capable of providing adequate levels of humidification.
- Has low resistance to flow and low dead space.
- Provides microbiological protection to the patient.
- Maintenance of body temperature.
- Safe and convenient to use.
- Economical.

Indications for humidification are:

- Flow rate more than 4 L/minute (2 L/minute for children <2 years), when using nasal cannula.
- Invasive ventilation.
- "Neck breathers"—Patients with a tracheostomy.
- Cystic fibrosis.
- Chest infection retaining secretions.

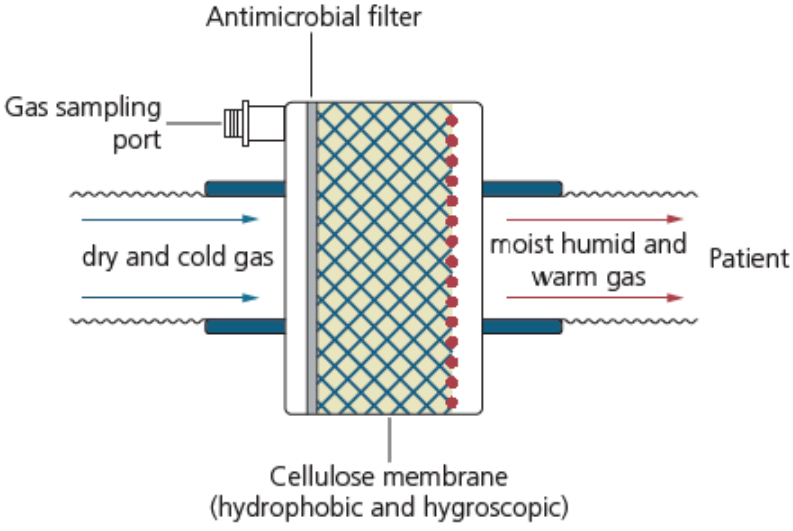
Heat and moisture exchanger

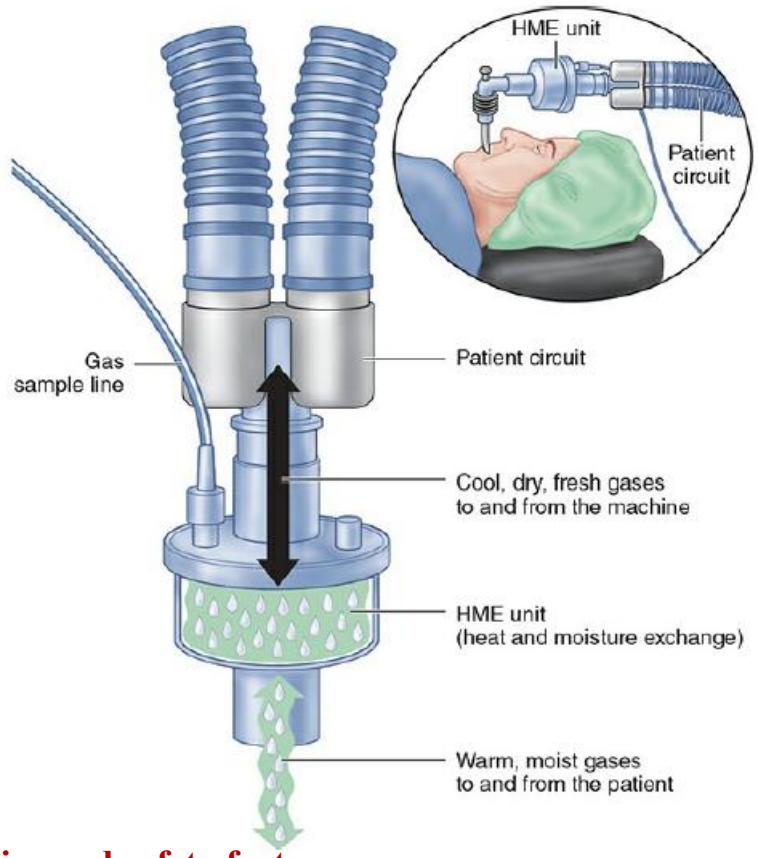
Exhaled heat and moisture are collected and made available to warm and humidify the following inspiration. These are the greatest sources of contaminated moisture to the patient. It should be changed every 12–24 hours.

These are compact, inexpensive, passive, and effective humidifiers for most clinical situations. Inspired gases are warmed to temperatures of between 29°C and 34°C. HMEs are easy and convenient to use with no need for an external power source.

Components:

1. Two ports that are designed to accept 15- and 22-mm-sized tubing and connections. Some designs have a provision for the connection of a sampling tube for gas and vapor concentration monitoring.
2. The head contains a medium, which can be:
   A. Hydrophobic, such as aluminum, to provide a simple and cheap but less efficient HME.
   B. Hygroscopic (water retaining), such as paper or foam impregnated with calcium chloride or lithium chloride to provide better efficiency
   C. Combined hygroscopic–hydrophobic to provide the best efficiency.





Problems in practice and safety features:

1. The estimated increase in resistance to flow due to these humidifiers ranges from 0.1 to 2.0 cm H_2O, depending on the flow rate and the device used.
2. Obstruction of the HME with mucus or because of the expansion of saturated heat-exchanging material may occur and can result in dangerous increases in resistance.
3. It is recommended that they be used for a maximum of 24 hours and for single-patient use only. There is a risk of increased airway resistance because of the accumulation of water in the filter housing if used for longer periods.
4. The humidifying efficiency decreases when large tidal volumes are used.
5. For optimal function, HME must be placed in the breathing system close to the patient.

Nebulizer

These produce a mist of microdroplets of water suspended in a gaseous medium. The smaller the droplets, the more stable they are. Droplets of 2–5 μm deposit in the tracheobronchial tree, whereas 0.5–1 μm droplets deposit in the alveoli. In addition to delivering water, nebulizers are used to deliver medications to peripheral airways.

There are three types of nebulizers: gas-driven, spinning disc, and ultrasonic.

1. Gas-driven (Jet) nebulizer

A capillary tube with the bottom end immersed in a water container.

2. Spinning disc nebulizer

This is a motor-driven spinning disc throwing out microdroplets of water by centrifugal force. The water impinges onto the disc after being drawn from a reservoir via a tube over which the disc is mounted.

3. Ultrasonic nebulizer

A transducer head vibrates at an ultrasonic frequency (e.g., 3 MHz). The transducer can be immersed into water, or water can be dropped onto it, producing droplets less than 1–2 μm in size. Droplets of 1 μm or less are deposited in alveoli and lower airways.

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