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History of smoking along with chronic respiratory diseases such as cystic fibrosis, chronic obstructive pulmonary disease, asthma, and bronchiectasis. Other patient-related factors that may contribute include smoking, immobility, sedation, muscle weakness, and dehydration.

A mucous plug occurs when excessive, tenacious mucous secretion blocks or “plugs” the airway lumen. Several mechanisms can improve secretion management and prevent mucous plugging.

Humidity
The use of an artificial airway bypasses the normal heat and moisture supplied to the alveoli by the upper airways. The lack of adequate moisture can result in dry, accumulated secretions that narrow the airway lumen, so using the correct humidifier for your patient is essential. Two systems of humidifiers are routinely used in mechanical ventilation: the heated humidifier and the heat moisture exchanger. The heated humidifier actively heats the inspired air and provides water vapor. The heat moisture exchanger passively provides heat and humidity by using the moisture and heat from the patient’s own exhaled gas. Several contraindications to the use of heat moisture exchanger include thick, bloody, or copious secretions; expired tidal volumes less than 70% of delivered; body temperatures less than 32°C; risk for aspiration; and acidotic state.

Maureen A. Seckel, RN, APN, ACNS-BC, CCNS, CCRN, replies:

You are correct that current evidence-based practice for suctioning an artificial airway does not recommend lavage or instillation of normal (0.9%) saline as a routine method for removing mucus. No research supports the use of normal saline for routine suctioning. Normal (0.9%) saline has not been shown to thin mucus or to remove or prevent formation of mucous plugs, and it may cause a decrease in arterial and venous oxygenation along with other potential harmful complications including increased risk of infection. Your observation about mucous plugging may be related to a variety of factors that are reviewed here.

Review of Physiology
Mucus is a mucin polymer composed of water and glycoproteins in a gel structure. It is continuously secreted by the goblet cells and submucosal glands to line the epithelium of the airways and to remove particles and debris from distal lung areas. Removal is facilitated by the mucociliary escalator that moves mucus distally from the respiratory bronchioles up proximally to the trachea. The cough reflex also assists in the clearance of mucus via a high-pressure, high-velocity flow of air and is effective in removing secretions from the large airways.

Patients with an artificial airway often have impaired mucociliary clearance and cough reflex because of infection or inflammation of the airway itself. Patients with an even higher risk for hypersecretion and mucous plugging are those with a history of smoking along with chronic respiratory diseases such as cystic fibrosis, chronic obstructive pulmonary disease, asthma, and bronchiectasis.
than 32°C (89.5°F); and spontaneous minute volumes exceeding 10 L/min. Heat moisture exchangers are also not recommended for use during aerosol treatments in the ventilator circuit and when using lung-protective strategies.6

Systemic dehydration may also play a role in “drying” secretions in patients with impaired clearance of mucus. The airway epithelium and mucus interact, resulting in adhesion of concentrated mucus.5

Mucolytic Agents
Currently, N-acetylcysteine is the most widely used mucolytic agent, despite there being little evidence to support its use.11 Inhaled hypertonic (3%-14%) saline solution improves mucociliary clearance in patients with cystic fibrosis.7,11 Additionally, inhaled dry powder mannitol has been used in patients with bronchiectasis and cystic fibrosis.12 The synthetic proteolytic enzyme rhDNase reduces viscosity and has also been used in patients other than those with cystic fibrosis.5 Mucolytic agents may be used in some patients to assist in secretion removal.

Secretion Removal and Adjuncts
Suctioning remains an essential component of airway management for patients who require mechanical ventilation and is the most common technique for removing secretions. Suctioning with hyperoxygenation before and after the procedure is recommended when excessive secretions are suspected.11,12 Indicators of excessive secretions include secretions in the tube, suspected aspiration, change in lung sounds, increase in peak airway pressure, increase in respiratory rate and/or frequent coughing, decrease in oxygenation, or sudden onset of respiratory distress.

Several adjuncts are available to potentiate removal of secretions in some select circumstances:

• Specialized catheters with a curved tip that angles to the left bronchus are available for facilitated suctioning of the left lung.1,2
• Manual hyperinflation with a self-inflating bag or “ambu bag” consists of delivering a large tidal volume breath, followed by an inspiratory hold and rapid release of pressure. A cough is simulated that results in mucus moving forward. Routine use of this technique is not recommended and may result in deleterious hemodynamic effects along with barotrauma and volutrauma.4,13
• Insufflation-exsufflation is done with a cough assist device that slowly delivers positive pressure to the airway and then quickly reverses to negative pressure. This shift simulates a cough and results in forward movement of mucus. This device has been used primarily in patients with neuromuscular weakness and despite use with patients receiving mechanical ventilation, little research with this device has been done in such patients.1,4,14
• Percussion and postural drainage are commonly used in patients with cystic fibrosis. There is not a lot of evidence supporting routine use for patients receiving mechanical ventilation, although this technique is used to stimulate cough and mobilize secretions.1,14,15
• Therapeutic bronchoscopy may be indicated for suspected atelectasis, collapsed lung, or excessive sputum.16

Summary
Many factors can cause the formation of mucous plugs in patients, and much of what is known has been from research done in patients with chronic diseases such as cystic fibrosis. Careful attention to both the humidification system and the patient’s fluid balance may help to prevent mucous plugging. The use of mucolytics and adjunct secretion removal may also be useful. What we do know, however, is that the routine instillation of normal (0.9%) saline is a practice that the research does not support as useful and that may actually be harmful. CCN

References

Financial Disclosures
None reported.

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Normal Saline and Mucous Plugging
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