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Aspiration Risk and Enteral Feeding: A Clinical Approach

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Enteral nutrition support is frequently delivered to the hospitalized patient who is unable to tolerate oral nutrition. It is considered safer and less expensive than parenteral nutrition. The most commonly identified complication of enteral nutrition is aspiration. It is difficult to correlate and diagnose aspiration, pneumonia, and pneumonitis as a direct result of enteral nutrition delivery. Studies defining aspiration complications related to tube feeding have lacked consistency in population and design. Despite the fear of aspiration, the healthcare professional recognizes the importance of early nutritional intervention in the hospitalized patient. This article will review aspiration related to tube feedings, identification of risk factors, and prevention strategies that will enable clinicians to deliver safe enteral nutrition to the hospitalized patient.

INTRODUCTION

Enteral nutrition is a commonly used modality in hospitalized patients and is preferred over parenteral nutritional support. Although enteral nutrition is considered safe and cost effective, it is not without complications. Aspiration is considered the most serious tube feeding complication. It may be clinically unimportant or develop into respiratory failure. Hospitalized patients who are intubated and receive tube feeding are at an especially high risk. The prevalence of aspiration pneumonia varies in the literature from 2% to 95%. Unfortunately, rigorous investigation of the incidence and risk factors for pulmonary aspiration are lacking. Discrepencies exist due to varying definitions of pulmonary aspiration, biased patient selection, differences in illness severity, a variance in type of feeding tube and method, and short follow-up intervals to name a few. Astute assessment and use of preventive measures during delivery of enteral nutrition can help decrease the incidence of aspiration.

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ASPIRATION

Aspiration occurs when material such as gastric contents, saliva, food, or nasopharyngeal secretions are inhaled into the airway or respiratory tract (1). An aspiration occurrence does not necessarily cause pneumonia. In the healthy population, microaspiration is common and pulmonary complications seldom occur. The hospitalized patient is at greater risk for developing respiratory compromise and pneumonia following an aspiration event because of impaired consciousness, altered airway defenses, and depressed immune function. Aspiration may present as silent, or with symptoms including coughing, choking, and acute respiratory distress (2).

PNEUMONIA

Pneumonia accounts for increased incidence of morbidity and mortality in the hospitalized patient (3). Pneumonia occurs when the bacteria that normally exist in the oral, nasopharyngeal, and gastrointestinal tract are aspirated into the lung. The hospitalized patient is extremely vulnerable to developing pneumonia because the pharynx may be colonized with hospital flora (2). Pneumonitis is caused by aspiration of gastric contents. The acidic nature of the gastric regurgitation causes inflammation of the lung tissue (1). Diagnosis of pneumonia and pneunonitis is confirmed by infiltrates on chest X-ray (3). The actual event of aspiration leading to pneumonia or pneumonitis is often missed and correlated with symptoms later.

REGURGITATION AND DYSPHAGIA

Regurgitation and dysphagia may play a role in aspiration, but should be addressed separately from aspiration. Regurgitation occurs when gastric contents reflux into the esophagus, pharynx, or oral cavity but do not enter the lungs. Many patients have gastric esophageal regurgitation that does not result in pulmonary aspiration. Dysphagia is difficult or dysfunctional swallowing (2). It may be present in the hospitalized patient with neurological compromise, sedation, or intubation (4). Dysphagia assessment by a speech pathologist can provide key information about the extent of dysphagia and whether silent aspiration is occurring. If a modified barium swallow is performed, care must be taken with dysphagia and aspiration interpretation. Delivery of enteral nutrition, infused gastrically, or into the small bowel, does not affect aspiration potential if the source is oropharyngeal secretions or food by mouth.

COUGH AND GAG REFLEXES

Assessment of the cough and gag reflex may be performed during dysphagia evaluation. The absence or presence of a gag reflex has not been shown to influence the risk of aspiration. Data show that patients with absent gag reflex do not necessarily aspirate and those with strong gag reflex may aspirate (5). Likewise, the cough reflex may or may not be elicited to prevent aspiration or signal an aspiration episode (silent aspiration). Therefore, diminished cough or gag reflexes are not reliable indicators of aspiration risk.

DETECTION METHODS

Glucose Testing

Enteral formulas contain significant carbohydrate (not necessarily *glucose*) and it is theorized that the presence of *glucose* in suctioned secretions at greater than 5mg/dL may indicate aspiration of formula (2). Reagent strips are used to test for the presence of glucose in suctioned tracheobronchial secretions. Studies of the validity of this method have shown that there is no reliable correlation between glucose levels in secretions and aspiration. Patients were found to have elevated glucose levels even when not tube fed (6,7). It is, therefore, not recommended that glucose testing be considered a reliable method for detection of aspiration.

Blue Dye Test

The blue dye test for aspiration is a traditional bedside practice that is based on the assumption that addition of blue food coloring or dye to the feeding formula helps the bedside clinician visualize aspiration events. In the 1980's and 1990's methylene blue was stored at the nurse's station and syringed from a multi-dose vial. Spillage, staining, and sterility became a concern and several products became available with FD&C Blue No. 1 blue food coloring in 5 mL single dose sterile squeeze vials.

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Table 1
University of Virginia Health System Blue Dye Protocol

After a review of the literature, the hospital Pharmacy and Therapeutics Committee approved the use of blue dye for certain patients.

Indications:
- Suspected reflux of secretions from beyond the pylorus back into the stomach (due to j-arm feeding tip location in proximal duodenum or through gastrojejunostomy opening)
- To help determine if j-arm of PEG/J has migrated back into stomach
- Suspected aspiration of tube feeding
- Suspected enterocutaneous fistula

Duration: No more than 24 hours
Amount: 2–4 drops **(NOT mL)** per 250 mL (1 can) of tube feeding formula

The FD&C Blue No. 1 product was considered safe in healthy humans and animal studies. Although it was never approved for use as an additive to enteral feeding, it became popular in the hospital setting for coloring enteral formulas (8). Few institutions have protocols for use of blue coloring. In a survey study, Methany, et al found that the amount of blue coloring used is up to the discretion of the nurse (9). It varied from a few drops for pale blue to several milliters for a royal blue shade. In 2000, case reports of discoloration of skin and urine were reported after addition of FD&C Blue No. 1 to enteral feedings of hospitalized patients (10). Deaths were reported in several patients and autopsy revealed blue, discolored organs. The deaths occurred in patients with conditions that increase gut permeability, such as sepsis, severe burns, trauma, shock, vascular surgery, and renal failure (8,11). These findings certainly suggest that this method of detection is unreliable, extremely unsafe, and should be abandoned.

Many institutions are re-evaluating their protocols for use of blue coloring in enteral formula. Although there are no studies to date supporting the accuracy of this detection method, many clinicians are still using this method in their practice. They must do so with careful consideration of their patient population and recognize the potential for harm with blue dye use. Of note, many institutions use methylene blue in place of blue food dye. The cost difference is significant: Methylene blue, 10 mL vial = $17.00; Steri-blue (recently taken off the market), 10 mL $3.50. Recommendations are to use FD&C Blue No. 1 available in single dose sterile squeeze vials and limit tinting of enteral formula to a few days only (12). See Table 1 for one institution's protocol.

ASPIRATION RISK FACTORS

Ongoing patient assessment is paramount in the safe delivery of nutrients via feeding tubes. A proactive approach is to assess the patient for risk factors that may contribute to aspiration. This can be challenging for the clinician, since there is no defining single risk factor for anticipating aspiration. See Table 2 for a list of factors associated with aspiration.

Supine Positioning

Supine positioning is associated with increased aspiration events. Studies concur that there is less aspiration and respiratory compromise with elevation of the head of the bed 30 to 45 degrees during enteral nutrition delivery (13–15).

Impaired Level of Consciousness

Level of consciousness (LOC) should be evaluated closely. Decreased LOC from sedation or illness can increase the risk of aspiration. The altered coordination

Table 2
Aspiration Risk Factors

- Supine Positioning
- Impaired level of consciousness
- Gastroesophageal reflux
- Neurological deficits
- Age >60 years
- Enteral intubation
- Malpositioned feeding tube
- Bolus vs. continuous
- Mechanical ventilation
- Poor oral health
- Inadequate nurse/patient ratio

between breathing and swallowing interferes with the patient's ability to protect the airway (16).

Gastroesophageal Reflux

Gastroesophageal reflux (GER) has also been identified as a risk factor for aspiration. Medical diagnosis and severity of illness may cause a decrease in esophageal sphincter pressure resulting in increased reflux and potential for aspiration (17). Drugs such as dopamine and acid suppressive agents, hyperglycemia, renal failure, and sepsis may contribute to delayed gastric emptying in the hospitalized patient (4). The resulting gastric distention may cause more frequent episodes of GER and possible aspiration. GER in combination with decreased LOC places the patient at a significantly greater risk for aspiration.

Neurological Deficits

Brain injured patients exhibit delayed gastric emptying and impaired lower esophageal sphincter as a result of increased intracranial pressure (16). Patients with chronic neurological disorders such as stroke, amyotrophic lateral sclerosis (ALS), and Parkinson's disease may exhibit varying degrees of dysphagia and silent aspiration.

Age >60 Years

Advanced age may play a role in aspiration risk. Older patients may have decreased swallowing ability for a variety of reasons (2). They are more likely to have multiple medical conditions, neurological deficits from an underlying disease process, and alterations in mental status from medications, or experience "sundowning," towards the end of the day thus increasing their risk.

Enteral Intubation

The existence of a nasally inserted enteral access device may also place patients at aspiration risk. This is presumed due to increased secretions from tube irritation, impairment of laryngeal function, and disruption of the esophageal sphincters during intubation.

Gastric vs. Small Bowel Feeding

Increased incidence of aspiration has not been clearly associated with any one enteral feeding method. Some clinicians hold the belief that transpyloric, small intestinal feedings protect the patient from reflux and subsequent aspiration. Studies to date have shown that this concept has not been clearly substantiated (14,18–20). Studies done in the ICU population concur with a recent prospective randomized trial by Neumann and Delegge (21). Sixty intensive care patients received either gastric or small bowel feedings with a 12-Fr nasal feeding tube. The gastric feedings demonstrated no increase in aspiration when compared to small bowel feedings. Unless a patient has a significant history of severe reflux, gastroparesis, refractory vomiting, or esophageal dysmotility, then initiation of gastric feedings is reasonable.

Malpositioned Tubes

Regurgitation, coughing, or vomiting usually results when tubes are incorrectly placed or distal tip migration into the esophagus or gastroesophageal junction has occurred. A new procedure for confirming feeding tube placement using a CO_2 monitoring device (thereby obviating the need for x-ray confirmation) shows promising results (22).

Bolus vs. Continuous Gastric Feedings

Rapid infusion of formula using the syringe-bolus delivery method may have a higher aspiration risk than lower volume continuous gastric feedings. Although there are no definitive studies to date, the bolus method of feeding may decrease lower esophageal sphincter pressure and increase the chance for reflux to occur (16).

Other Risk Factors

Other risk factors that have been identified in the literature include tracheal intubation, mechanical ventilation, seizures, poor oral health, and inadequate nurse to patient ratios (16). Despite multiple risk factors, enteral nutrition remains the safest and most cost effective means to reduce catabolism in hospitalized patients who cannot take nutrients orally (23). Implementation of prevention strategies is a key factor for improving the safety of enteral feeding delivery. See Table 3 for a list of prevention strategies.

Table 3
Prevention of Aspiration

- Maintain head of bed > 30 degrees
- Routinely verify tube placement
- Clinical assessment of GI tolerance:
  - Abdominal distention
  - Fullness
  - Discomfort
  - Excessive residual trends
- Remove naso/oro enteric tubes as soon as possible

PREVENTION

Head of Bed Elevation

There is good evidence that the 30 to 45 degree semi-recumbent body position minimizes reflux and potential aspiration. Ibanez, et al showed in two studies that there is less gastroesophageal reflux and aspiration when nasogastrically-fed, mechanically ventilated patients are maintained in the semi-recumbent position rather than supine (14,24). Drakulovic, et al also examined body position in 86 mechanically ventilated patients and found that nosocomial pneumonia was highest in enterally fed patients in the supine position (13).

Head of bed elevation is an easy and economical nursing intervention for most hospitalized patients. Grap, et al collected measurements of backrest elevation in a medical intensive care unit and found that 86% of patients were maintained in the supine position despite enteral feedings (25). There was no change in hemodynamic status when semi-recumbent positioning was maintained. The rationale for supine positioning was attributed to convenience, patient comfort, and usual practice on the unit. The evidence overwhelmingly supports head of the bed elevation during feeding. This will significantly lessen the risk of aspiration and should be practiced without exception.

Verify Tube Placement

Another nursing measure for prevention of aspiration is frequent monitoring of tube placement. Nasally or orally placed feeding tubes are generally anchored to the nose or face with tape. These tubes become easily dislodged into the esophagus with normal patient movement. Tube length and secure tape should be checked every four hours during tube feeding. Nasal and oral tubes are indicated for < 3–4 week regimens and should be removed as soon as feasible (26).

Gastric Aspirates

It is standard practice in many institutions to check aspirates in gastrically-fed patients to determine if formula is being retained in the stomach, theoretically placing the patient at risk for gastroesophageal reflux and potential aspiration. The general practice is to hold feedings for gastric residual volume of > 150–200 mL. This amount is not standardized and there are no studies to date that can predict an actual "safe" amount for gastric residual volume (27). Sometimes patients do not receive adequate nutritional support because feedings are being held for a predetermined, institution-specific high gastric residual. A more practical approach is to monitor the patient for complaints of fullness, abdominal distention and discomfort, adequate bowel function, and trends in elevated gastric residuals. Constipation can be the cause of these complaints, and a consistent bowel program may improve the residual volume. Unfortunately, there is no clear evidence that has established what volume constitutes an unsafe high residual and the assessment and intervention is left to the clinician at the bedside.

It has been suggested that promotility drugs such as metoclopramide and erythromycin may promote gastric emptying and improve high gastric residual volumes. In a prospective, randomized, controlled trial of 305 intensive care patients with nasogastric tubes it was determined that rates of nosocomial pneumonia and mortality were not different between the metoclopramide and the placebo group (28). In a review of randomized trials by Booth, et al, promotility agents demonstrated no positive effects on clinical outcomes (29). A trial period on one of these drugs may be beneficial for an individual patient with chronic high gastric residual trends, but ongoing, and, diligent assessment of clinical status is paramount.

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SUMMARY

Delivery of enteral nutrition can be challenging in the hospitalized patient. Assessment of patient risk factors will help in the selection of the best enteral access route and method of feeding each individual patient. A team approach with the patient, nurses, dietitians and physicians will provide the best strategy for safe and successful nutritional support.

Clinicians at the bedside are the front line of defense in preventing aspiration, the most serious complication of tube feeding. Simple nursing measures like elevation of the head of the bed have been shown to decrease aspiration risk. It is time for clinicians to abandon the practices of glucose testing of pulmonary secretions and addition of blue dye to enteral feeding and rely more on clinical monitoring of abdominal and pulmonary assessment of tube fed patients. This article has reviewed the current understanding of aspiration risk in enterally-fed patients in the hospital setting. Prevention strategies to decrease that risk have also been provided. ■

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