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SAFE PRACTICES in Patient Care

Helping to promote a culture of safety

Pneumonia, one of the most prevalent nosocomial illnesses, incurs significant morbidity and mortality and additional healthcare costs. Because of its serious- ness, it is identified as a priority in a variety of national standards and guidelines. Nursing care can play a major role in helping to reduce pneumonia, especially aspiration-related disease. Ms. McGinnis's article provides a brief review of factors that are associated with pneumonia, particularly those that pertain to enteral tube feeding.

Cardiovascular surgery can correct ailments that adversely impact quality of life or increase mortality if untreated, but it is not without risks and possible complications. Nutrition support is an important facet of postoperative care as patients struggle with numerous metabolic and physiologic factors affecting their nutritional status and oral intake. Ms. Wolin and Foster describe how early enteral nutritional support can improve outcomes such as ICU length of stay, ventilator days, and ventilator-associated pneumonia in cardiovascular surgical patients.

World Health Organization Partners with Joint Commission and Joint Commission International to Eliminate Medical Errors Worldwide.

The collaboration between JCAHO and WHO will focus worldwide attention on patient safety and best practices that can reduce safety risks to patients, and coordinate international efforts to spread these solutions as broadly as possible. The next issue of *Safe Practices* will include a more detailed description of this new initiative.

Aspiration Pneumonia due to Enteral Tube Feeding:

How Can Nursing Care Help with Prevention?

CONTINUING EDUCATION FOR NURSES CE FREE

By Carol McGinnis RN, MS, CNSN

Pneumonia is one of the most prevalent nosocomial illnesses. It incurs significant morbidity and mortality as well as longer hospital stays and additional healthcare costs. Because of its seriousness, it is identified as a priority in a variety of national standards and guidelines, including the Ventilator Bundles of the 10,000(100 K) Lives Campaign of the Institute for Healthcare Improvement, the American Association of Critical Care Nurses (AACN), the Institute for Clinical Systems Improvement (ICSI), the Centers for Disease Control (CDC), and the North American Summit for Aspiration in the Critically Ill Patient (NA Summit). It is also identified as one of the Nurse Sensitive Indicators of the National NQF Foundation (INI.org).

Nursing care can play a major role in helping to reduce pneumonia, especially aspiration-related disease. This article will provide a brief review of factors that are associated with pneumonia, particularly those that pertain to enteral tube feeding. Additionally, it will summarize current recommendations to reduce the occurrence of aspiration-related pneumonia (AP).

Risk factors

According to the CDC, there are four major categories of risk factors for pneumonia[1]:

- colonization of the mouth or stomach area
- conditions favoring reflux
- prolonged use of ventilators/exposure to contamination, and
- host factors, such as extremes of age, malnutrition, and severe underlying conditions

Elderly and nursing-home residents are at higher risk for AP. Pneumonia occurs 10 times more often in long-term care facilities than in the community. Impairment of host defenses and an increase in bacterial concentrations in the oropharynx are two factors that increase susceptibility to AP in the elderly.[2] Another risk factor is ventilatory support, with a rate of about 1% of patients per ventilator day.[3] Other risk factors have been identified as previous episodes of aspiration, decreased level of consciousness, neuromuscular disease or structural abnormalities of the gastrointestinal (GI) tract, vomiting or regurgitation, a need for prolonged supine position, and persistent high gastric residual volumes (GRV). Minor risk factors include intermittent bolus feeding, delayed gastric emptying, poor oral hygiene, and advanced age.[4] Some risk factors can be changed; others, such as advanced age or neuromuscular diseases, obviously cannot. Nursing care and appropriate use of safety technology and products can play a significant role in minimizing the preventable risks of pneumonia.

Pneumonia is often acquired as a result of aspiration, which can occur either from aspiration of oropharyngeal contents or from the reflux or retrograde passage of esophageal or gastric contents into the larynx and lungs. The differentiation of these two etiologies is important because their prevention and treatment differ; however, it may be difficult to positively determine the cause of AP.

The aspiration of food may occur during eating or as a delayed response to oral food intake, e.g., when food is pocketed in the oral pharynx and later aspirated into the lungs. It may also result from microaspiration of material, such as salivary secretions, from the oropharynx.

The oral consistency of food may be altered (e.g. thickened) or food withheld and

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Early Enteral Nutrition Following Cardiovascular Surgery: *Safe Practice and Current Trends*

by Carol Wolin-Riklin, MA, RD, LD, CNSD, and Jan Foster, RN, PhD, MSN, CCRN

The cardiovascular surgical patient is a unique challenge for the multidisciplinary critical-care team. The nature of cardiovascular surgery brings a high degree of risk to the patient. The clamping of blood vessels during surgery risks, hypoperfusion to the gut, kidney, and spinal cord. Hypothermia and deflation of a lung during surgery increase the risk of systemic and pulmonary complications.

Typically, these patients present in their sixth decade or greater of life.[1] Comorbidities associated with advanced age that increase surgical risk include nutritional compromise related to diabetes, renal dysfunction, pulmonary insufficiency, and congestive heart failure. Decreased lean body mass, cardiac cachexia, and decreased immunocompetence related to an aging immune system will also impact surgical morbidity and mortality.[2]

Although cardiovascular surgery can correct ailments that adversely impact quality of life or increase mortality if untreated, it is not without risks and possible complications. Nutrition support is an important facet of postoperative care as patients struggle with numerous metabolic and physiologic factors affecting their nutritional status and oral intake. Sedation, analgesia, endotracheal intubation, and difficulty in body positioning can preclude oral intake. Pulmonary dysfunction with increased work of breathing will impair the safety of oral intake as the coordination of respiratory efforts and food consumption places the patient at an increased risk for aspiration. Hyperglycemia and renal function may limit the nutrient load a patient can tolerate. Sustained inadequate nutrition support in the metabolically stressed patient leads to losses of lean body mass and immune suppression. Loss of diaphragmatic and respiratory muscle mass reduces effective breathing and may prolong mechanical ventilation. These factors have the potential to increase ventilator days, ventilator-associated pneumonia (VAP), and intensive care unit length of stay (ICU LOS).[3]

Early enteral nutrition support

Early enteral nutrition support has been shown to improve outcomes such as ICU LOS, ventilator days, and VAP in critically ill surgical patients.[4] A decrease in the translocation of bacteria from the gut to continue the gut barrier function and preserve gut mucosal integrity has been demonstrated.[5] Standards published by the American Society for Parenteral and Enteral Nutrition in 2002 recommend the use of protocols to guide enteral nutrition support.[6] Evidence-based nutrition protocols have been implemented in the critically ill and have promoted the increased use of enteral feeding, earlier enteral introduction,[7] and increased provision of kilocalories to the patient.[8] The early inception of enteral nutrition (48–72 hours after surgery) is based on an early enteral feeding algorithm and a standardized enteral feeding protocol developed for the cardiovascular intensive care unit (CVICU) that provides direction for patient screening and initiation and delivery of enteral nutrition. The enteral protocol contains guidelines for the placement of the feeding tube, enteral formula selection, initiation of feeding, and goals for attaining a minimum critical volume of formula. Criteria defining signs and symptoms of enteral intolerance are also listed for nursing use in managing the enteral feeding process safely and effectively.

Benefits of early enteral nutrition

Promoting the nutritional status of the hypermetabolic and catabolic cardiovascular surgical patient during the postoperative recovery phase is essential for improving patient outcomes. Early enteral nutrition causes fewer infectious complications than parenteral nutrition, and it promotes hemodynamic stability.

Fewer infectious complications

Enteral nutrition is the preferred route for the provision of nutrients in patients with functional gastrointestinal tracts; however, because oral intake is not always possible in the early postoperative period, insertion of enteral feeding tubes becomes necessary. Parenteral nutrition has been associated with an increased incidence of multiple organ dysfunction, pneumonia, and infectious complications.[9] Nicholas et al found that infectious complications were reduced and days of total parenteral nutrition were decreased by 45% overall in a study of 229 surgical patients who underwent transendoscopic feeding tube placement distal to the ligament of Treitz.[10] The provision of nutrients may blunt the inflammatory response to the invasive cardiovascular surgical repair, which may reduce the incidence of infection, severe sepsis, and septic shock, and result in improved organ function after cardiovascular surgery.[11] Wound healing is enhanced, and sternal infection rates—a common source of sepsis—are decreased with postoperative ingestion of nutrients.

The use of immune-enhancing enteral nutrition may also decrease infectious complications in patients who are already septic. Rokyta et al administered low-dose post-pyloric enteral nutrition to 10 critically ill patients with severe sepsis who were mechanically ventilated and hemodynamically stable. They found that all patients remained hemodynamically stable during delivery of enteral nutrition, with improved systemic and hepatic-splanchnic blood flow, avoiding further deterioration to septic shock.[12]

In a larger study of 181 septic critically ill patients, Galban et al found that an immune-enhancing enteral formula resulted in significant reduction in mortality rate and superimposed infections. They administered an enriched formula to the experimental group and a commonly used high-protein formula to the control group. Mortality for the experimental group was 17 of 89 compared to 28 of 87 in the control group ($p<0.05$), and there was a reduction in bacteremia in 7 of 89 versus 19 of 87 ($p<0.05$).[13]

Ventilator-associated pneumonia is the leading cause of death from nosocomial infection, occurring in 10%–25% of mechanically ventilated patients for a mortality rate of 43%.[14] In a study of 52 injured mechanically ventilated patients in whom enteral nutrition was initiated immediately, only 33% of 27 subjects developed pneumonia compared with 64% of 25 subjects ($p=0.050$) in whom enteral nutrition was initiated later than 24 hours following admission.[15] Cardiovascular surgical patients with sustained mechanical ventilator support are also at risk for VAP and can benefit from early enteral nutrition.

Hemodynamic stability

Cardiovascular surgical patients are in danger of hemodynamic instability and compromised splanchnic bloodflow due to intraoperative clamping of major arteries, blood loss, and fluid shifts. Catecholamine support is often necessary in the early postoperative phase. There is concern that bloodflow is shunted away from splanchnic circulation during vasopressor support; however, Revelly et al found that introduction of enteral nutrition early in the postoperative period increased cardiac output and splanchnic bloodflow during administration of dobutamine and/or norepinephrine. In addition, patients were able to appropriately utilize nutrients.[16]

Hemodynamically challenged patients requiring vasopressor/inotropic support

should be monitored frequently for hypotensive changes and abdominal distention. These signs indicate a need to discontinue enteral nutrition until bowel integrity is assessed. Bowel necrosis is not a common occurrence in patients provided with early enteral nutrition.[17]

Cardiovascular surgery can be a tremendous insult to the individual. Full attention to all metabolic and physiologic needs is required for complete healing and return to functional status devoid of complications. Nutrition is fundamental to every bodily process and must be addressed early in the postoperative phase. Enhanced healing, prevention of infection and infectious complications, and restoration of hemodynamic stability are benefits of early nutrition, and they are requisite for a patient's participation in cardiac rehabilitation.

Patient screening

Candidates for early enteral feeding must be assessed before any feeding begins. Cardiovascular surgical patients may have complications that prevent enteral feeding or limit the patient to trophic enteral feeding of 15 mL/hour (Table 1).[18] Only after cardiovascular surgical patients have been evaluated for contraindications to enteral nutrition can they be considered candidates for tube placement and nutrition. Figure 1 shows the algorithm for safe introduction of enteral feeding.

Enteral access

Placement of an enteral nutrition tube into the stomach versus the small bowel has been a controversial topic. Gastric access is often faster and easier to obtain than small-bowel access and poses no increased risk of aspiration pneumonia.[19] Before a gastric tube is placed, patients should be evaluated for factors that raise the risk of aspiration during gastric enteral feeding (Table 2). Careful screening will ensure that appropriate enteral access routes are chosen. Gastric feeding tubes for enteral nutrition can be placed if no or one gastric risk factor is present. If a patient has 2 or more gastric risk factors, a small-bowel enteral tube is preferred.[20] After the enteral tube has been placed, the bed should be kept at an angle of ≥30 to reduce the risk of VAP and aspiration pneumonia.[21]

Enteral protocol

Once the cardiovascular surgical patient has been evaluated for any contraindications to enteral nutrition and has been screened for the optimal tube access route, formula selection is the next step in the protocol. In the CVICU, formula selection is influenced not by location of the tube but by individual patient needs, which dictate a full-strength polymeric, a semi-elemental, an immune-enhancing, or a renal formula. The nutrition-support dietitian facilitates formula selection and determines patient-specific goal rates.

Indirect calorimetry in cardiovascular surgical patients has demonstrated a general caloric need of 25 kcal/kg/day.[22] For cardiovascular surgical patients without abdominal surgery, feeding should be initiated at 15 mL/h and be increased by 15 mL/h every 8 hours until the goal of 60 mL/h is achieved. For cardiovascular surgical patients with abdominal surgery, feeding should be initiated at 15 mL/h for 24 hours; if this is tolerated, the rate should be increased by 15 mL/h every 12 hours to the goal of 60 mL/h. The goal rate for the renal formula is 40 mL/h, as it is hyperosmolar and concentrated.

Patients should be frequently monitored for signs and symptoms of enteral-feeding intolerance (Table 3). The enteral-feeding protocol should identify the various types of intolerance that a patient may develop and should include a guide to managing the related signs and symptoms. Management techniques may include stopping the enteral feeding, decreasing the enteral infusion rate, administering a prokinetic, or changing the tube placement.

Hydration

In the recovery phase, the cardiovascular surgical patient faces an increased risk of failure or dysfunction of the multiple systems that help regulate fluid status. The functional status of the pulmonary, renal, hepatic, and cardiac systems will affect the fluid volume that a patient can tolerate.

There is no standard volume of free water per kilogram body weight in this unique surgical population. Hydration requirements are determined daily by clinical status and laboratory data. Use of an enteral feeding pump with an autoflush feature (e.g., KANGAROO ePUMP™ Enteral Feeding Pump, Kendall) that allows for patient-specific volumes of free water to be infused automatically every hour is advantageous. Smaller, more frequent bolus volumes are better tolerated by elderly cardiovascular surgical patients.[23] The small bowel is more tolerant to smaller bolus volumes since it does not have the reservoir capacity of the stomach for a larger bolus of free water or enteral feeding.

Contraindications to enteral feeding

- Hemodynamic instability requiring pressor support
- Bowel obstruction
- High-output fistula
- Ileus
- Gut ischemia
- Nasogastric output >1200 mL in 12 hours
- Use of paralytics

Table 1.

Gastric-feeding risk factors

- Altered mental status
- Gastric residual volumes >500 mL
- Recent CVA
- Intra-abdominal surgery
- Gastroparesis
- Pancreatitis
- Supine position
- Mechanical ventilation
- Use of RotoProne bed
- Use of paralytics

Table 2

Signs and symptoms of intolerance to enteral feeding

- Abdominal distention
- Gastric residual volume >250 mL
- Diarrhea: >500 mL stool for 2 days or 3 liquid stools per day
- Emesis
- Gastrointestinal bleeding
- Gastroesophageal reflux
- Complaints of abdominal discomfort
- Nausea

Table 3

Glycemic control

Glycemic control is an important adjunctive therapy with enteral feeding. Critically ill cardiovascular surgical patients often experience hyperglycemia,[24] with both diabetics and non-diabetics at increased risk. This is related to possible epinephrine use, infection, metabolic stress response, and insulin resistance.[25] Poor glycemic control may be harmful to myocardial function and clinical outcomes. Krinsley noted an increase in unfavorable outcomes in patients with poor glycemic control in association with acute myocardial infarctions, acute coronary syndromes, and cardiovascular surgery.[26]

Van den Berghe conducted a landmark prospective, randomized, controlled study involving critically ill patients requiring ventilator support admitted to a surgical intensive care unit.[27] The study enrolled 1548 patients, and 970 of them had had cardiac surgery. The surgical patients were randomized either to receive continuous intensive insulin therapy to maintain glycemic control at 80–110 mg/dL or to receive conventional treatment for glycemic control with glucose maintenance at 180–200 mg/dL. The surgical patients randomized to receiving continuous intensive insulin therapy with tight glycemic control of 80–110 mg/dL had a decrease in morbidity and a 32% reduction in mortality. Some of the clinical benefits of glycemic control of 80–110 mg/dL include decreased infection rates, strengthened immune integrity, and a decrease in organ system dysfunction.

Hyperglycemia can delay gastric emptying in the critically ill patient. In comparison to euglycemia, during periods of hyperglycemia there is a decrease in gastric motility. Impaired gastric emptying affects gastric enteral feeding tolerance and could necessitate reevaluation for prokinetic use or small-bowel feeding due to increased aspiration risk.[28]

Glycemic control of 80–110 mg/dL is a proactive measure that can be initiated in a standardized protocol in conjunction with an enteral feeding protocol to promote improved outcomes in the critically ill cardiovascular patient.

KANGAROO ePUMP™ Enteral Feeding Pump (Kendall)

Conclusion

The enteral feeding algorithm and the enteral feeding protocol incorporate current concepts from evidence-based literature to provide the cardiovascular surgical patient with early and safe enteral nutrition support. The enteral feeding protocol helps to increase the delivery of nutrient substrates[29] and to address the risk factors that will impede safe and efficient nutrition support. Enteral nutrition is the preferred pathway to deliver nutrients and is a means to modify the role of the gastrointestinal tract during the inflammatory storm after surgery.

Monitoring the clinical effects of enteral nutrition is essential for patient safety. The clinician needs to be vigilant for signs and symptoms of gastrointestinal intolerance or for the development of contraindications to enteral nutrition. If the gastrointestinal complications cannot be resolved, consideration must be given to withdrawing enteral nutrition. Contraindications require the termination of enteral nutrition and the reevaluation of parenteral nutrition for the patient.

Cardiovascular surgical patients are in a dynamic state; they require frequent monitoring and assessment. Assuring adequate early enteral nutrition and tight glycemic control will promote improved recovery in the critically ill cardiovascular surgical patient.

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Aspiration Pneumonia due to Enteral Tube Feeding — continued

substituted with enteral feeding to reduce the potential for aspiration with oral intake. Yet it is important to remember that the aspiration of normal oropharyngeal secretions into the airways from this route may still occur. Aspiration of GI contents due to reflux of substrates from the stomach or esophageal area may occur as a result of relaxed esophageal tone or poor sphincter control, e.g., a relaxed or incompetent gastroesophageal sphincter, and poor gastric emptying. Aspiration of GI fluids can cause either bacterial or chemical pneumonitis and may be complex to prevent as well as treat.

Enteral feeding

Nutrition is important to maintain the immune system and general functional status. When patients are unable to meet their nutritional needs by oral intake, the enteral route via the GI tract or tube feeding should be used for nutritional support whenever feasible. Enteral nutrition (EN) may be associated with an increased incidence of aspiration,[5,6] but AP has many potential contributors, some of which can be altered to reduce the risks of aspiration and subsequent pneumonia. The goal of nursing care is to focus on patient assessment and risk reduction and continue to provide adequate nutrition via the enteral route wherever possible.

Location of feeding tube

The route of aspiration may help to determine whether the patient needs a tube that ends in the stomach or one with the tip in the small intestine. The nasogastric (NG) or gastrostomy tube (G tube) is often chosen when aspiration is felt to occur via oral intake. Postpyloric feeding may be preferred when aspiration results from the reflux of gastric contents, especially when measures to promote gastric emptying and reduce reflux have been unsuccessful.

Studies that compare aspiration after stomach feeding as opposed to small bowel feeding have shown conflicting results. Heyland et al[7] and Montecalvo8 have found that small bowel feeding may significantly reduce the incidence of AP, as compared to gastric feeding; however, other studies, including a recent meta-analysis, did not find any difference in the incidence of AP after either type of feeding.[9] According to the NA Summit,[4] aggregated data from meta-analysis show a reduction of AP after small bowel feeds vs. gastric feeds.

Aspiration may occur for other reasons despite small bowel feeding, including increased gastric secretions in response to small bowel stimulation.[10] When the patient is fed via the small bowel with no NG tube in place, one means to assess gastric emptying and suction of a high fluid load from the stomach is lost. When there is potential for a high gastric fluid

Table 1. **Summary of recommendations to prevent aspiration associated with tube feeding**

North American Summit

- Reassess need, level, and choice of agents used for sedation
- Reevaluate need for opioid analgesia and minimize use of narcotics
- Keep HOB >30-45° (provided patient is positioned so that bend of bed is at patent's lower back); if not possible, position patient in reverse Trendelenberg at 30-45°
- Change infusion from bolus/ intermittent to continuous
- Optimize oral health
- Consider moving high-risk patient to a monitored unit with increased staffing
- Additionally considerations: Prokinetic agents, continuous aspiration of subglottic secretions, kinetic beds
- Gastric residual volume (GRV) recommendations:
  - Stop TF for overt regurgitation or aspiration
  - Withhold feeds and reaasess tolerance for GRVs>500 ml
  - Return GRVs of <500ml to the patient
  - GRVs of 200-500ml should prompt careful bedside evaluation and initiation of an algorithmic approach to reduce risk

CDC

- In the absence of medical contraindication(s), elevate the HOB of a patient at high risk for aspiration at an angle of 30-45? [e.g., a person receiving mechanically assisted ventilation and/or who has an enteral tube in place (category 11)]
- Oropharyngeal cleaning and decontamination with an antiseptic agent: develop and implement a comprehensive oral-hygiene program (that might include the use of an antiseptic agent) for patients in long term-care facilities who are at high risk for health-care-associated pneumonia (11)

AACN Practice Alert

- Expected practice: All patients receiving mechanical ventilation as well as those at high risk for aspiration (e.g., decreased level of consciousness; enteral tube), should have the HOB elevated at an angle of 30-45°, unless medically contraindicate

load, e.g., in the ICU where medication may delay gastric emptying, an NG tube may be indicated in addition to transpyloric feeding until GI function has improved. Another option is use of a nasojejunal gastric decompression tube, which may accomplish both purposes, i.e., simultaneous jejunal feeding and gastric suctioning, with the use of a single tube.[11]

Many factors impact the patient's ability to empty the stomach, including medications, specific clinical states such as diabetes, hyperglycemia (independent of diabetes), electrolyte abnormalities, sepsis, and trauma. Sometimes, an NG feeding tube may need to be advanced to the small bowel or an existing G tube may need to be converted to a gastrojejunal (GJ) tube to continue feeding in the presence of gastroparesis. If this conversion is difficult to accomplish at a specific time, a nasoduodenal or nasojejunal tube may be considered as a temporary measure, until the stomach empties better or until jejunal access can be established via the G tube or separate insertion.

The NA Summit recommends that "small bowel feeding with the tube at or below the ligament of Treitz" (an identifier for feeding into the jejunum as opposed to the duodenum) is "strongly recommended for patients with documented aspiration and persistent intolerance" to gastric feedings or for those with more than two major risk factors for AP.4 Postpyloric feeding is also recommended for slowed gastric emptying. A commercially available tube that will allow for simultaneous gastric suction and post pyloric feeding (DOBBHOFF™ Nasogastric Jejunal Feeding tube, Kendall) may be used on these patients to help minimize the risk of AP.

A limitation of postpyloric feeding is difficulty in placing small bowel feeding tubes via the nasal route at the bedside, yet this practice is often desirable to avoid or reduce reliance on radiology or endoscopy to help place tubes, which increases staff time and hospital costs. Common factors in the success of blind feeding tube placement include the practitioner's experience and use of a feeding tube that helps the tube tip to "slide" more easily through the pylorus. Cost reduction and patient satisfaction indicators can be used to justify the nursing hours to develop and maintain this skill.

Feeding schedules

Advocates who believe that less formula in the stomach reduces the opportunity for reflux recommend continuous feeding. Others have suggested that intermittent feeding allows the gastric pH to become more acidic between feedings, reducing the bacterial flora of the stomach contents and, theoretically, the risk of AP. One study of intermittent vs. continuous feeding showed similar rates of intragastric colonization and ventilator-assisted pneumonia (VAP), although continuous feeding was better tolerated than intermittent feeding.[13]

The NA Summit lists bolus or intermittent feeding as an additional risk factor for aspiration and recommends the use of continuous as opposed to bolus feeding to reduce this risk in critically ill patients.[4] However, the lifestyle of more mobile, less ill patients who need enteral feeding is also important, and changes in the regimen to promote a more normal lifestyle may be indicated as the risk factors for aspiration decrease.

Size of nasal feeding tube

Larger tubes have been hypothesized to irritate the esophagus and interfere with normal esophageal sphincter function. Several studies have failed to find a significant difference in aspiration between larger and smaller tubes,[13,14] but the North American Summit does list tube size as an additional risk factor for aspiration.[4] Patient comfort should dictate the use of the smallest tube possible. Nurses can help to reduce the plugging of smaller tubes by instilling water before and after each individual medication is administered (not mixing any meds) and taking care with specific medication formulations.

Assessment of tube placement

The status of feeding tube placement is obviously a safety concern for aspiration. Listening for the air bolus over the abdomen to assess the proper placement of a nasally inserted stomach tube can provide a false sense of security. X-ray verification continues to be widely used for assessment of initial placement or if questions arise later regarding placement. This practice is expensive and time-consuming, therefore other methods of assessing tube placement continue to be researched in an effort to avoid or reduce its use. When combined with other clinical factors, pH assessment is sometimes used to assess stomach tube placement.[15]

Capnography (a means to detect CO2) to detect inadvertent placement of the feeding tube in the airway has been researched. A new single-use product (CO_2NFIRM NOW™ CO_2 detector, Kendall) is now available to detect whether CO_2 is present during feeding tube placement. (The next issue of *Safe Practices* will discuss the use of capnography to minimize inadvertent tube placement.)

Once tube placement is verified, continued vigilance is important to prevent displacement or to detect it right away, should it occur. One method sometimes used to identify outward tube displacement is to note external length when ideal placement is confirmed and mark where it exits the nare and monitor the amount external periodically while being mindful that internal displacement, such as curling in the

mouth, could lead to aspiration as well.

Gastric residual volume

A common nursing practice is to assess tolerance by monitoring gastric residual volume (GRV), yet the amount of GVR that indicates poor tolerance and the risk for aspiration is still unknown. High GRVs are not necessarily a sign of poor tolerance and a low volume is no guarantee that a patient is not at risk for aspiration.

People produce about 1500 ml of saliva and 3000 ml of gastric fluid daily,[16] so obtaining stomach fluid should not be viewed as unusual. The amount of fluid depends on whether the tube sits in the pool of stomach fluid. Different residuals will be obtained from a G tube that is placed high in he stomach and an NG tube with a tip that sits low in the antrum. GVR correlates poorly with gastric emptying, reflux, and aspiration.[17]

There is no standardized practice for when to hold enteral feeding and when to return feeding to the patient. Tube feeding is often held in response to one high GRV; this practice may lead to suboptimal nutrition. Researchers have found that GRVs are poorly correlated with the incidence of regurgitation or aspiration.[5]

The NA Summit recommends the combination of GRV assessment with other clinical assessments (See Table 1 for more specific recommendations for GRV).[4] Other clinical assessment of tolerance to tube feeding includes monitoring for abdominal distention and/or firmness, feeling of fullness or nausea, and bowel status. Loose stools do not necessarily indicate adequate bowel function, as they may be all that can get beyond a partial obstruction. The quality of bowel sounds, e.g., tympany, may be helpful, but the absence of bowel sounds is not considered to be a reason to delay the initiation of enteral nutrition. The appearance of the GVR may provide a clue to GI status and the patient's digestive process as well. In other words, nurses should assess the "big picture" without undue reliance on GVR.

Monitoring for aspiration

Once a "sacred cow", the routine use of blue food color to detect pulmonary aspiration has essentially been abandoned after a Public Health Advisory warned of related risks.[18] Not only were serious adverse outcomes including death reported, but there was a lack of clear evidence to indicate that it was an effective way to detect aspiration.[19] Glucose oxidative strips have been researched as a means to detect aspiration, but they have not been shown to be helpful due to a high incidence of false positives and negatives.[20] Pepsin is under investigation to detect reflux into the esophagus, but it is not currently being routinely used.[21] Due to the shortcomings of aspiration detection, a focus on prevention may be more appropriate at this time.

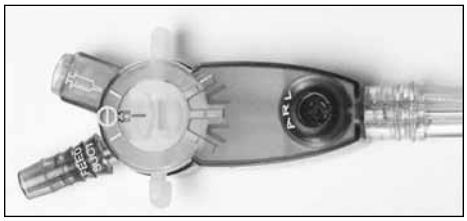

Fig. 1. GiENTRI™Port

Patient positioning

Patient positioning continues to be correlated with AP in clinical studies. For example, a three-fold reduction in the incidence of VAP has been noted when the head of the bed (HOB) is maintained at 45° as opposed to a supine position.[22] The CDC Guidelines, NA Summit, AACN Practice Alert, and 100 K Lives Campaign recommend a HOB elevation of at least 30-45° for patients at high risk of aspiration, including those with mechanical ventilation and/or an enteral tube, when not contraindicated (Table 1).

Use of a bundle approach, i.e., combining the prophylaxis of peptic ulcer disease and deep vein thrombosis with elevation of the HOB and a sedation vacation by 35 critical care units has been associated with an average reduction of 44.5% in VAP. How much each element contributed to this reduction is unclear, but the processes and structural changes adopted to assure adherence to the bundle approach were felt to be significant factors in the improvement of VAP rates.[23] Monitoring HOB elevation as a performance-improvement project or including a place to check HOB elevation on the routine clinical ICU checklist on an hourly basis are ways that nursing can positively impact practice and, in turn, outcomes.[23] Other suggestions to promote this practice are offered by the AACN.[24]

Medications

Narcotics, propofol, and dopamine may inhibit GI motility and should be used judiciously. When they must be used, close monitoring of bowel status and employing means to stimulate the bowel are indicated. Sedating medications have been linked to difficulty in protecting the airway. Anticolinergics promote dry mouth, which in turn may alter bacterial flora. Histamine receptor blockers and proton pump inhibitors for ulcer prophylaxis or gastroesophageal reflux disease (GERD) may alter the stomach pH and allow bacteria to proliferate; this process would not normally occur in the acidic environment of the stomach. Selective decontamination of the GI tract has been suggested as a means to reduce bacterial gut flora but is not recommended for practice at this time. The NA Summit recommends the use of a prokinetic agent (metoclopramide or Reglan®) when gastric emptying is reduced.[4]

Other recommendations: oral, pharyngeal and gastric

Other recommendations have been suggested for the prevention of AP, especially as they relate to the reduction of bacterial colonization. Oral, pharyngeal, and gastric secretions may play a role in reducing pneumonia. Oral or dental disease, a reduction in salivary flow, antibiotic therapy, systemic illness, and malnutrition may contribute to changes in normal flora and bacterial adherence to epithelial cells.[6]

Ventilator-related factors, including condensate in the circuit system and poor care of suctioning devices, have been implicated as a potential source of microbial growth in the aspirated secretions of ventilated patients. Enteral feeding systems and related equipment have been shown to be sources of bacterial growth[24]. Means to minimize touch contamination can include a closed system stopcock system (GiENTRI™Port, Kendall) for feeding, suctioning, irrigation without contamination. (see Fig.1) Other measures such as meticulous syringe care may help reduce microbial growth in the GI tract.

Normal oral anatomy and microbial flora prevent pathogens from colonizing secretions. The natural balance changes with critical illness and when the mouth is not used for feeding. Dental caries or other oral conditions that introduce harmful pathogens may exist in young and older patients and may promote bacteria, such as gram-negative organisms, to proliferate. With microaspiration, these pathogens can gain access to the respiratory tract.

Studies have shown that good oral care can play a significant role in reducing pneumonia. Sole et al[26] found potential pathogens in the mouths of all 20 patients who had been ventilated for at least 24 hours. In addition, 67% had pathogens cultured from their sputum and 94% of tonsil suction devices were colonized.

Two studies have shown a reduction of nosocomial pneumonia in heart-surgery patients who had 0.12% chlorhexidine gluconate oral rinses. DeRiso et al[27] found a 69% decrease in respiratory tract infections and a reduction in antibiotic use, while Houston[28] noted a reduction in nosocomial pneumonia among patients intubated more than 24 hours who had a high level of bacterial colonization. Bacteria can gain access to the respiratory tract from overt aspiration or microaspiration, even in the intubated patient.[29] The presence of a cuff on the endotracheal (ET) tube is not a guarantee that the patient will not aspirate secretions from above.

Sole et al[30] found that among 1,665 nurses and respiratory therapists, only 48% had policies that addressed oral care and only 37% addressed oral suctioning. Frequent oral care, including tooth brushing, should be promoted to reduce the risk of AP and enhance patient comfort.

Aspiration has been associated with ET tubes. Oral secretions become subglottic secre-

tions that pool above the cuff of the intubated patient.[31, 32] The NA Summit recommends continuous subglottic suction as a consideration to reduce aspiration.4 The pressure of the ET tube or tracheal cuff should be adequate to decrease the likelihood of aspiration of subglottic secretions. Suctioning secretions often and prior to extubation and employing care to reduce microbial growth in suction equipment are felt to be important factors in reducing AP.

Other adjunctive measures that may reduce AP include using a noninvasive pressure vent (NPPV) and/or extubation as soon as possible, adequate nursing care staff, and kinetic beds.

Summary

This article has explored factors that have correlated aspiration to pneumonia, especially those related to enteral tube feeding. It has reviewed and suggested nursing interventions that may help to improve patient outcomes.

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1. The cardiovascular surgical patient is at increased risk for nutrition support complications due to:

a. Hypoperfusion of organs and vessels
b. Organ cross contamination during surgery
c. There is no increase in nutrition support risk after surgery
d. immunosuppression

2. The following increase risk of intolerance to gastric feeding:

a. Supine position
b. Paralytic use
c. Altered mental status
d. All of the above

3. Which of the following would indicate the need for small bowel feeding:

a. Gastric residuals >500 mL
b. Mechanical ventilation
c. Bed at 30 degree angle
d. Hyperglycemia

4. What are contraindications to enteral feeding?

a. Use of sedation, large residuals
b. Parenteral nutrition, nasogastric output >1200 ml over 24 hours
c. Paralytic ileus, gut ischemia
d. Use of inotropic medications, fistulas

5. What are signs and symptoms of enteral feeding intolerance?

a. Gastrointestinal reflux, constipation
b. Extreme thirst, hyperactive bowel sounds
c. Elevation in BUN and creatinine
d. Gastrointestinal bleed, emesis

6. Tight glycemic control of 80–120 mg/dL promotes:

a. Wound healing
b. Immunocompetence
c. Decreased risk of postoperative infection
d. All of the above

7. Aspiration precautions do not include:

a. Head of the bed at 30° angle
b. Monitoring gastric residuals
c. Routine prokinetic administration
d. Assessment of patient for gastric risk factors

8. The benefits of initiating early enteral nutrition support in the cardiovascular surgical patient include:

a. Decreasing ICU LOS and ventilator days
b. Increasing lean body mass during critical illness
c. Increasing gut permeability
d. Providing hypocaloric enteral feeding

9. Risk factors for aspiration include all of the following except:

a. Colonization of the mouth or stomach area
b. Host factors such as extremes of age, malnutrition and severe underlying COPD
c. Use of antibiotic therapy
d. Conditions favoring reflux

10. Which of the following statements is <u>false</u>:

a. A three-fold reduction in the incidence of VAP has been noted when the head of the bed (HOB) is maintained at 45° angle as opposed to a supine position
b Monitoring HOB elevation as a performance-improvement project or including a place to check HOB elevation on the routine ICU checklist on a periodic basis are ways that nursing can positively impact practice and, in turn, outcomes
c In a study by Sole et al, only 48% of nursing care units surveyed had policies that addressed oral care and only 37% addressed oral suctioning. Frequent oral care, including tooth brushing, should be promoted to reduce the risk of AP and enhance patient comfort.
d. Gastric feeding is recommended for those with several major risk factors for aspiration.

11 Which of the following statements is <u>false</u>:

a. Gastric residual volumes are poorly correlated with the incidence of regurgitation or aspiration
b. The practice of monitoring GRVs may impede ETF because of the inappropriate cessation and reduced infusion time
c. In order to help standardize practice in this area, enteral feeding should be held for one hour for residual volumes of 100 ml or more
d. Gastric residual volumes should not be relied on alone to determine tolerance to ETF

12. Recommendations to reduce aspiration pneumonia include all of the following <u>except</u>:

a. Meticulous oral care
b. Reliance on the cuff pressure of the trach to prevent aspiration
c. Extubate as soon as possible or use a noninvasive pressure vent
d. Minimize microbial growth in enteral tube feeding

13. Which of the following statements is <u>false</u>:

a. Glucose oxidative strips should be used to help detect aspiration whenever it is suspected
b. The routine use of blue food color to detect aspiration has been abandoned after a Public Health Advisory warning against its use.
c. Prokinetic agents should be considered when gastric empyting is delayed
d. Due to the shortcomings of aspiration detection, a focus on prevention may be more appropriate

14. Which of the following statements is <u>false</u>:

a. When patients are unable to meet their nutritional needs by oral intake,the enteral route via the GI tract or tube feeding should be chosen for nutritional support whenever feasible
b. When there is potential for a high gastric fluid load, an NG tube may be indicated in addition to transpyloric feeding, until GI function has improved
c. Postpyloric feeding may be preferred when aspiration results from the reflux of gastric contents, especially when measures to promote gastric emptying and reduce reflux have been unsuccessful
d. Tube feeding should be discontinued and parenteral nutrition should be used whenever aspiration is suspected

15. The liberal use of medications such as narcotics and propofol help to keep the patient still and therefore less likely to aspirate.

a. True
b. False

16. Specific measures can be incorporated into the plan of care to help to reduce aspiration.

a. True
b. False

Participant's Evaluation

What is the highest degree you have earned (circle one) ? 1. Diploma 2. Associate 3. Bachelor's 4. Master's 5. Doctorate

Indicate to what degree you met the objectives for this program: Using 1 = Strongly disagree to 6 = strongly agree rating scale, please circle the number that best reflects the extent of your agreement to each statement.

	Strongly Disagree					Strongly Agree
1. Discuss at least 3 factors associated with aspiration pneumonia and enteral tube feeding	1	2	3	4	5	6
2. Evaluate patient risks for aspiration pneumonia	1	2	3	4	5	6
3. Incorporate actions into the plan of care that will help reduce the prevalence of aspiration pneumonia	1	2	3	4	5	6
4. Discuss the benefits to early enteral nutrition support in the postoperative CV patient	1	2	3	4	5	6
5. Describe the gastric risk factors that place cardiovascular surgical patients at an increased risk for gastric feeding intolerance	1	2	3	4	5	6
6. Describe the enteral feeding protocol for a postoperative CV patient	1	2	3	4	5	6

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	A	B	C	D		A	B	C	D
1	☐	☐	☐	☐	9	☐	☐	☐	☐
2	☐	☐	☐	☐	10	☐	☐	☐	☐
3	☐	☐	☐	☐	11	☐	☐	☐	☐
4	☐	☐	☐	☐	12	☐	☐	☐	☐
5	☐	☐	☐	☐	13	☐	☐	☐	☐
6	☐	☐	☐	☐	14	☐	☐	☐	☐
7	☐	☐	☐	☐	15	☐	☐		
8	☐	☐	☐	☐	16	☐	☐		

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