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PREVENTING RESPIRATORY COMPLICATIONS OF TUBE FEEDINGS: EVIDENCE-BASED PRACTICE

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The most dreaded complication of tube feedings is tracheobronchial aspiration of gastric contents. Strong evidence indicates that most critically ill tube-fed patients receiving mechanical ventilation aspirate gastric contents at least once during their early days of tube feeding. Those who aspirate frequently are about 4 times more likely to have pneumonia develop than are those who aspirate infrequently. Although a patient's illness might not be modifiable, some risk factors for aspiration can be controlled; among these are malpositioned feeding tubes, improper feeding site, large gastric volume, and supine position. A review of current research-based information to support modification of these risk factors is provided. (American Journal of Critical Care. 2006;15:360-369)

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Tube feeding is favored over parenteral nutrition in most critically ill patients because the former is thought to preserve the integrity of the gut and cause fewer infectious complications.[1,2] As with most therapies, however, tube feeding has associated risks. The most serious potential complication is tracheobronchial aspiration of gastric contents. Far more common than witnessed large-volume aspirations is a series of clinically silent microaspirations. For example, using formula containing microscopic beads, McClave et al[3] found that 30 of 40 gastric-fed, critically ill patients had at least 1 microaspiration during the early course of the patients' tube feedings.

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In a similar study,[4] 320 of 360 critically ill tube-fed patients had at least 1 microaspiration (as defined by the presence of pepsin in tracheal secretions). In that study,[4] pneumonia occurred 4 times more often in patients who aspirated gastric contents frequently than in patients who aspirated gastric contests infrequently. Thus, it is reasonable to assume that strategies to prevent aspiration also may reduce aspiration-related pneumonia.

Most tube-fed critically ill patients receiving mechanical aspiration aspirate gastric contents.

The extent of pulmonary injury caused by aspiration depends on the volume and characteristics of the aspirated material. Large-volume aspirations can seriously impair gas exchange and cause asphyxia. Even small aspirations of gastric acid can injure the pulmonary capillaries and cause exudation of protein-rich fluid. In an animal model,[5] the volume of highly acidic fluid (pH <2.5) must exceed 0.3 to 0.4 mL/kg to cause significant injury and signs. Injury due to low pH is less likely in a patient who aspirates a mixture of gastric juice and enteral formula than in a patient who aspirates gastric juice only because most enteral formulas have pH values close to 6.6 and thus buffer gastric pH to near neutral levels. If the aspirated gastric fluid contains large concentrations of pepsin and refluxed materials from the small bowel (eg, trypsin and bilirubin), the probability of lung injury is increased.[6-8] Pulmonary injury due to aspirated enteral formula most likely varies according to the osmolality and other characteristics of the formula. After the initial lung injury caused by aspiration, microorganisms typically present in gastric contents increase the probability of aspiration-related pneumonia.[9,10]

Although a patient's underlying illness or injury might not be modifiable, other risk factors for aspiration can be controlled. Among these are malpositioned feeding tubes, gastric feeding despite markedly impaired gastric emptying, large gastric residual volume (GRV), and the supine position. The following is a review of current research-based information that supports modification of these risk factors.

Malpositioned Feeding Tubes

"Aspiration by Proxy" Due to Tubes Inadvertently Positioned in the Respiratory Tract

Administration of enteral formula or medications directly into the lung via a tube inadvertently positioned in the respiratory tract is sometimes referred to as "aspiration by proxy." For example, a 70-year-old woman died after receiving a bolus feeding into the lower lobe of her right lung via a small-diameter tube assumed to be in the stomach; this assumption was based on hearing air insufflated through the tube.[11]

Most inadvertent insertions of tubes into the lung occur via the right main bronchus.[12] Figure 1 depicts a feeding tube extending downward from the right main bronchus until the tube eventually perforates the lung into the pleural space. Tubes also can enter the lung via the left main bronchus. For example, in a recent case,[13] a standard nasogastric tube was placed into a patient's left pleural space; auscultating the abdomen for air insufflated through the tube produced a false-positive for correct placement of the tube.

It is unclear how often feedings are administered via tubes positioned in the respiratory tract; however, multiple anecdotal cases have been reported.[11,14-16] Medications can also be administered directly into the lung via malpositioned nasogastric tubes. For example, a case[17] was reported in which adult respiratory distress syndrome developed in a 30-year-old man after the administration of activated charcoal with sorbitol into the right main bronchus. The feeding tube had originally been correctly positioned but was accidentally pulled out and then reinserted past the endotracheal tube.

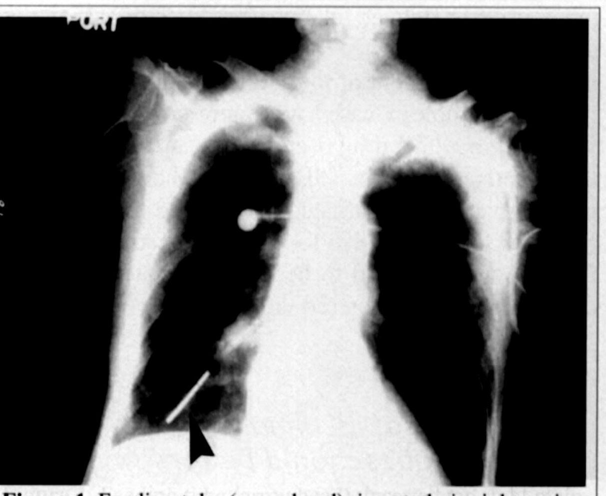

Figure 1 Feeding tube (arrowhead) inserted via right main bronchus entered pleural space through lower part of right lung.

The ausculatory method is not accurate for differentiating between respiratory and gastrointestinal placement of feeding tubes.

Radiography remains the gold standard for ruling out respiratory placement of blindly inserted tubes.[18-22] For example, testing the pH of a feeding tube aspirate,[12,23] observing the appearance of the aspirate,[24] and using end-tidal carbon dioxide monitoring[25] are not sufficiently accurate to ensure nonrespiratory placement of blindly inserted tubes in high-risk patients. Further, no studies have been reported confirming that the auscultatory method is accurate in differentiating between respiratory and gastrointestinal placement of feeding tubes. However, multiple anecdotal reports[12,26] have been published of instances in which the method has failed, often with tragic results. For this reason, in the practice alert on verification of feeding tube placement,[27] the American Association of Critical-Care Nurses recommends radiographic confirmation of correct position for all blindly placed tubes before the initial use of the tubes for administration of feedings or medications in critically ill patients.

Most institutions mandate radiographs before small-bore tubes are used for feedings, especially when the tubes require stylets for insertion. However, considerably less attention is paid to large-bore nasogastric tubes used to deliver feedings and/or medications; an assumption that bedside methods are infallible in detecting faulty placement of these tubes is unwarranted.

For example, a case[28] was reported in which a 13-year-old girl with a drug overdose was able to speak after the introduction of an 18F tube into her left lung and pleural space. Air insufflated through the tube may have produced a false-positive for gastric placement. Because the tube was assumed to be in the stomach, activated charcoal was administered via the tube.

Placement of all blindly placed feeding tubes should be confirmed by radiography.

Aspiration Associated With Malpositioned Gastrointestinal Feeding Tubes

After respiratory placement of a newly inserted feeding tube has been ruled out on the basis of radiographic evidence, clinicians must ensure that the tube remains in the desired gastrointestinal site (either the stomach or the small bowel) during feedings. A feeding tube is considered malpositioned when its ports end in the esophagus or when a small-bowel tube dislocates upward into an atonic stomach. Occasionally, a gastric feeding tube will migrate into the small bowel; however, this situation usually does not increase the risk for aspiration.

Although it is improbable that a tube can become displaced into the respiratory tract after being correctly positioned, it is not unusual for it to move up or down in the gastrointestinal tract.[29] For example, in a study by Kesek et al,[30] twenty-eight of 73 patients had dislocated nasogastric tubes. A tube may be pulled out by a confused patient, or it may be accidentally dislodged during the delivery of care or during movement in bed.[31]

Increased Risk for Aspiration. In one study,[4] displacements of feeding tubes were detected in 25 of 201 critically ill patients followed up prospectively for a period of 3 days; the 25 patients with malpositioned tubes had a significantly higher incidence of aspiration than did those whose tubes remained correctly positioned. Of the 25 malpositioned tubes, 2 were displaced upward into the esophagus; the remaining 23 were displaced upward from the small bowel into the stomach.[32]

Risk for aspiration is high when a tube's ports are situated in the esophagus, especially if the patient has other risk factors for regurgitation and aspiration (eg, a distended abdomen and a low level of consciousness). For example, I know of a fatal case of aspiration in which an elderly woman with ascites received a rapid infusion of several liters of polyethylene glycol 3350 solution via an 18F tube whose ports were in the distal esophagus.

Assessment for Tube Displacements. After correct placement of a tube has been confirmed by radiography, a simple bedside assessment for displacement is observing for a change in the external length of the tube. For example, in a prospective study[32] of 201 critically ill tube-fed patients, 2 tubes were dislocated into the esophagus. One tube moved from the small bowel to the esophagus; the other, from the stomach to the esophagus; the external lengths of the tubes increased 32 cm and 12 cm, respectively. Although a change in the external length of a tube usually occurs with displacement, the distal tip of a tube can spontaneously dislocate upward in the gastrointestinal tract with no obvious change in the external length of the tube.[29]

Observing for changes in the volume of fluid withdrawn from feeding tubes can also be helpful in detecting tube dislocations. For example, an increase in the maximal volume of aspirate occurred in 17 of 23 instances in which small-bowel tubes were displaced upward into the stomach (mean increase 50.7 mL, SD 16.5 mL, range 10-330 mL).[32]

A major change in the tube's external length indicates a need to confirm correct placement by radiography.

Measuring the pH of a feeding tube aspirate is of limited benefit when continuous feedings are in progress, because enteral formula usually buffers local secretions to near neutral levels. However, although rare, a decrease in the pH of an aspirate to 5 or less may signal the need to obtain a radiograph to determine if a small-bowel feeding tube has dislocated into the stomach.[32] If tube feedings are turned off for several hours in preparation for diagnostic tests or procedures, an opportunity exists to more accurately use pH and aspirate appearance to determine tube location. For example, both methods worked well in detecting a situation in which a patient's gastric decompression tube migrated to the small bowel while his weighted small-bore feeding tube (assumed to be in the small bowel) was actually positioned in the stomach (Figure 2). In this situation, the pH of the bile-stained fluid withdrawn from the

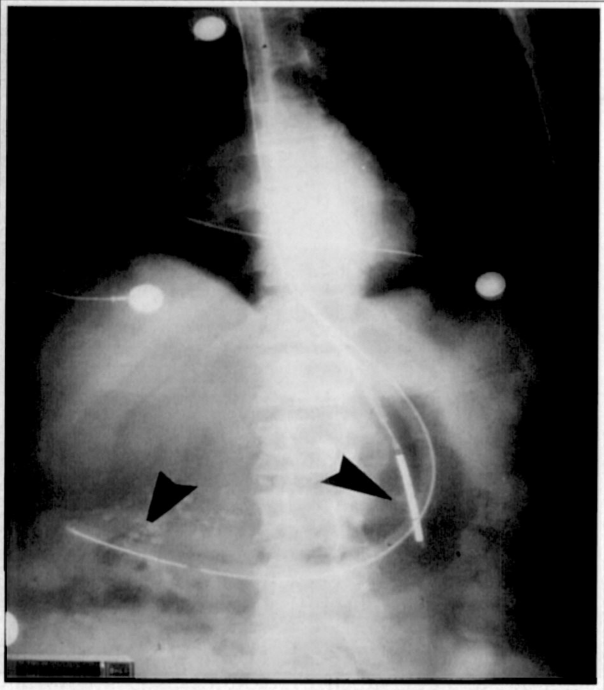

Figure 2 Large-diameter sump tube (left arrowhead) situated in duodenum; small-bore weighted feeding tube (right arrowhead) in stomach.

large-bore decompression tube was 7; in contrast, the pH of the clear fluid withdrawn from the small-bore feeding tube was 2.

Evidence exists that the auscultatory method cannot be used to differentiate between gastric and small-bowel placement of stationary tubes.[33] However, clinicians skilled in blind insertions of small-bowel tubes report that they can detect variations in sound intensity and quality as a tube is advanced from the stomach into the small bowel.[34,35]

Because bedside assessments for tube placement during feedings are not consistently effective, clinicians are encouraged to also review results from routine chest and/or abdominal radiographs to help determine if a tube has remained in the desired location.[36] Fortunately, radiologists usually refer to the position of feeding tubes when reporting results from such radiographs (regardless of the reasons the radiographs were obtained). For example, in a review of 174 daily chest radiographs in 74 children, Valk et al[37] found that 15% of the nasogastric tubes were malpositioned.

After reviewing recommendations from expert panels, caregivers may be encouraged to monitor the position of feeding tubes more closely during feedings. For example, the Centers for Disease Control and Prevention[38] recommends "routine verification of appropriate feeding tube placement to prevent aspiration." The same recommendation was made by the panel that prepared the consensus statement[39] of the North American Summit on Aspiration in the Critically Ill Patient.

Gastric Feeding When Gastric Emptying Is Impaired

Gastric Versus Small-Bowel Feedings

When gastrointestinal motility is normal or only slightly impaired, tube feedings are usually safe by either the gastric or the small-bowel route because feedings and gastrointestinal secretions are propelled forward, minimizing the risk for regurgitation and aspiration. In this situation, intragastric feedings are favored over small-bowel feedings because compared with small-bowel tubes, gastric tubes are easier and less expensive to place. However, when gastric motility is moderately or seriously impaired, gastric feedings accumulate in the stomach along with gastric secretions and predispose to reflux and aspiration. Factors common in critically ill patients that impair gastric emptying include the underlying disease or injury state, low level of consciousness, and use of medications that slow gastric emptying (eg, opioids).[40-42]

On the basis of a meta-analysis of 9 randomized controlled trials, Marik and Zaloga[42] concluded that critically ill patients who are not at high risk for aspiration should have a nasogastric tube placed at the time of admission to the intensive care unit (ICU) for the early administration of enteral feedings. If large GRVs occur, use of prokinetic agents should be considered to improve tolerance to gastric feedings; when use of prokinetic agents is not successful, a small-bowel feeding tube should be considered for continued enteral nutritional support.

Selection of the tube-feeding site is often based on the available expertise in tube placement and the degree of risk for that patient.

Clinicians agree that small-bowel feedings are preferred when patients are intolerant of gastric feedings or aspiration has been detected.[39,43] Some clinicians prefer to begin with small-bowel feedings when the risk for intolerance to gastric feedings is high.[44] Guidelines offered by a group of Canadian authors[45] call for choosing the site of feeding tubes on the basis of the skill of ICU personnel in placing small-bowel feeding tubes. For example, routine use of small-bowel feedings is recommended when ICU personnel are capable of placing small-bowel tubes easily at the bedside. When this procedure is not readily feasible because of untrained personnel, the authors[45] recommend considering small-bowel tube feedings only for patients who repeatedly have large GRVs and are not tolerating adequate amounts of feedings into the stomach.

Similar recommendations have been made by others; for example, Jabbar and McClave[46] recommend that the final choice for the level of tube feeding be based on institutional factors (eg, available expertise) and the degree of risk for the individual patient. The consensus statement[39] of the North American Summit on Aspiration in the Critically Ill Patient recommends that small-bowel feedings be used when patients are intolerant of gastric feedings or have had aspiration. The statement also suggests that positioning the tip of a feeding tube in the proximal jejunum may further reduce the risk for aspiration in critically ill patients (presumably because the probability of duodenogastric reflux is lessened).

Education of Personnel in Placement of Small-Bowel Tubes

Most likely placement of feeding tubes in the small bowel would be used more often to reduce aspiration in high-risk patients if the procedure could be performed with minimal effort and cost by bedside nurses. Although a few hospitals have specially trained nurses or physicians to place small-bowel feeding tubes at the bedside, most do not.[34,44]

When a patient's physician has determined that a small-bowel feeding site is needed to reduce the risk for aspiration, it usually is a nurse's responsibility to place the tube. Because minimal training in insertion of small-bowel tubes is provided in basic nursing programs, many nurses are poorly prepared to perform this task. Several groups of nurse investigators[35,44,47] have shown that with proper training, nurses can often insert small-bowel feeding tubes at the bedside (greatly reducing inconvenience and cost associated with fluoroscopic placements). For example, a clinical nurse specialist worked with a dietitian to insert small-bowel feeding tubes in 74 critically ill patients in a surgical ICU; the team achieved an 86% success rate.[44]

In situations in which tubes cannot be placed at the bedside, patients may need to be transported from the ICU to the radiology department for fluoroscopic placement; this requirement entails increased risk for the patients and loss of nursing time. Even if available within the unit, fluorometry is associated with increased cost. A variety of techniques have been described to help clinicians achieve successful small-bowel tube insertions at the bedside.[34,35,44,47,48]

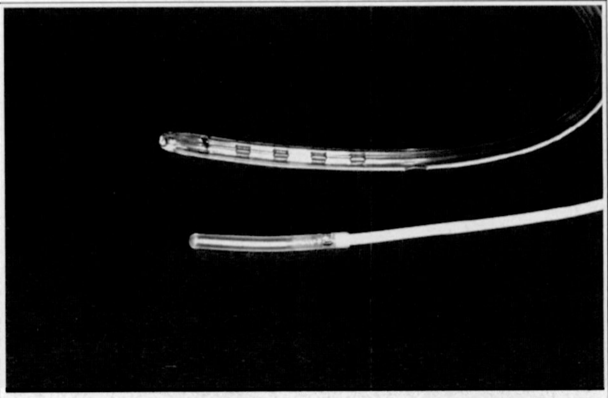

Figure 3 Comparison of diameter and port configuration of 18F sump tube and 10F polyurethane feeding tube.

Large GRVs

Difficulty in Obtaining Accurate GRV Measurements

Withdrawal of gastric contents via a syringe may not remove the total volume of fluid present in the stomach. For example, Miller et al[49] used the dye-dilution technique to calculate gastric volume in 19 infants and compared the results with volumes obtained by syringe aspiration. When the calculated volume was compared with fluid obtained by syringe aspiration, the latter was significantly smaller. A number of variables may affect GRV measurements; among these are the type of feeding tube used to make the measurement, the position of the ports of the tube in the stomach, and the patient's position.

The type of feeding tube used, position of the ports, and position of the patient affect the amount of gastric residual volume.

Evidence indicates that GRVs may be underestimated when small-bore tubes with few ports are used. For example, a study[50] of 645 dual measurements made by using small-bore feeding tubes and large-bore sump tubes concurrently present in the stomachs of 62 critically ill patients indicated that large GRVs were detected 2 to 3 times more often with large-bore sump tubes. Figure 3 depicts the difference in size and port configurations of the 10F polyethylene feeding tubes and the 18F sump tubes used in the study. Obviously, the potential for accurate GRV measurement increases as the diameter of the tube increases. Also, having multiple ports spread over a length of several centimeters increases the probability that at least one of the ports will be located in a pool of gastric fluid.

Regardless of the type of tube used, the location of the tube in the stomach affects the ability to measure GRVs. For example, a tube whose ports are near the gastroesophageal junction is not likely to rest in a pool of gastric fluid (especially if the patient is sitting up). The effect of a patient's position (supine or side lying) on the ability to measure GRVs is unclear. For example, in 10 critically patients, McClave et al[51] found no difference in GRV values obtained when the patients were supine or in the right lateral decubitus position. However, GRVs were significantly larger in 20 low-birth-weight infants when the volumes were measured with the infants in the left lateral position (as compared with the right anterior oblique and prone positions).[52]

Controversy About the Value of GRV Measurements

Despite recognized measurement problems, it is usual practice to measure GRVs in critically ill patients at least every 4 to 6 hours. Those who favor this practice postulate that a large GRV predisposes to gastroesophageal reflux and subsequent aspiration.[4,53] However, other investigators[3,54] think that GRV measurements provide little useful information.

Studies That Support a Relationship Between GRV Measurements and Aspiration. A study[53] of 153 critically ill patients with 18F nasogastric tubes indicated that pneumonia was significantly more likely to develop in patients with upper digestive intolerance (defined as 1 GRV >500 mL, 2 consecutive GRVs between 150 and 500 mL, or vomiting) than in patients without intolerance (43% vs 24%, $P = .01$). The authors[53] emphasized that their findings justify the use of GRVs to monitor enteral feeding in critically ill patients. Although no direct measure of aspiration was obtained, the inference can be made that the higher incidence of pneumonia in patients with large GRVs was at least partially related to increased aspiration.

In a prospective study[55] of 244 critically ill gastric-fed patients, a direct comparison was made between aspiration and GRVs. Almost half (n = 128) of the patients were fed through 10F polyurethane tubes; the remainder (n = 116) were fed through 14F or 18F sump tubes. The patients' tracheal secretions were tested for the gastric enzyme pepsin; detection of pepsin was considered evidence of aspiration of gastric contents. A total of 3380 GRVs were measured; 135 (55.3%) of the 244 patients consistently had GRVs less than 100 mL; 42 (17.2%) had 2 or more GRVs of 150 mL or greater, and 22 (9%) had 2 or more GRVs of 200 mL or greater. Patients in the latter groups had significantly higher percentages of pepsin-positive tracheal secretions than did those whose GRVs were always less than 100 mL (mean 44.2%, SD 4.1% versus 33.4%, SD 2.1%, $P = .018$; and mean 46.6%, SD 5.1% versus 33.4%, SD 2.1%, $P = .02$, respectively). Although the findings were statistically significant, aspiration occurred relatively often in the patients whose GRVs were consistently less than 100 mL.

Although small- and large-diameter tubes were about equally represented in the study, more than two thirds of the large GRVs were detected with large-diameter sump tubes. This finding suggests that GRVs may have been underestimated in the patients who had 10F tubes. The most important finding from this study is that large GRVs increased the risk for aspiration; however, the absence of large GRVs did not preclude aspiration (possibly because of measurement error).

A study reported by McClave et al[51] more than a decade ago included 10 critically ill patients who were observed for a period of 8 hours. The findings indicated that the GRV of concern in critically ill patients most likely is 200 mL when measured by using a nasogastric tube located in the antrum or fundus and 100 mL when measured by using a gastrostomy tube located on the anterior gastric wall. Although none of the patients had evidence of aspiration, abnormal radiographic results and physical findings occurred more often when GRVs were 100 mL or greater.

Studies That Do Not Support a Relationship Between GRV Measurements and Aspiration. In a study in which the paracetamol absorption test was used to measure gastric emptying, Cohen et al[54] found no difference in GRVs between 24 patients with slowed gastric emptying and patients with normal gastric emptying.

In a study reported in 2005, McClave et al[3] found no connection between large GRVs and aspiration in a population of 40 critically ill tube-fed patients who received enteral formula marked with yellow microscopic beads. A total of 587 tracheal samples were collected and examined for a yellow discoloration under fluoroscopy; a discoloration was considered evidence of aspiration. Of the 40 patients, 21 had nasogastric tubes and 19 had gastrostomy tubes. Unfortunately, the type and size of nasogastric tubes used in the study were not specified. Only 6.2% of the GRVs were greater than 150 mL, and only 1.5% were greater than 400 mL; thus, the statistical power may have been inadequate to determine the relationship between aspiration and large GRVs.

In a clinical study, Elpern et al[56] examined GRVs and aspiration in 39 critically ill gastric-fed patients, most of whom had 18F feeding tubes. GRVs exceeded 150 mL on 28 measurements in 11 patients. Aspiration was considered present if formula was visible in tracheal secretions. Only 4 patients met the criterion for aspiration. Missing from the reported results was information about the relationship between large GRVs and aspiration. The inference could be made that large GRVs did not matter because aspiration occurred infrequently. However, the method used to determine aspiration lacked sufficient sensitivity. Even enteral formula heavily stained with dye was insensitive for detecting aspiration in an animal model after multiple forced aspirations.[57]

Large GRVs During Small-Bowel Feedings

Because feeding into the small bowel can stimulate gastric output, large GRVs may also be a problem when patients are receiving small-bowel feedings. For example, gastric output almost doubled in a group of 51 trauma patients after the introduction of jejunal feedings.[58] Before the jejunal feedings were used, the mean daily gastric output was 302 mL (SD 20 mL); after jejunal feedings were started, the mean daily gastric output increased to 588 mL (SD 47 mL; $P=.01$).

Other investigators have reported the occurrence of large GRVs during small-bowel feedings. For example, in one study,[50] GRVs of 100 mL or greater were detected in 11.6% (n = 103) of 890 measurements obtained by using the gastric sump tubes of 75 critically ill patients receiving small-bowel feedings; similarly, 5.4% (n = 48) of the measurements were 150 mL or greater. Thus, measurement of GRVs via gastric sump tubes may be needed when small-bowel feedings are started in some critically ill patients. If a GRV is large, concurrent gastric decompression may be required. Some evidence indicates that concurrent use of gastric suction during small-bowel feedings markedly reduces aspiration.[4]

High gastric residual volumes may occur even with small-bowel feedings.

Review of Expert Panel Recommendations

Because of conflicting research data, a review of the opinion of expert panels on GRVs is helpful. Unfortunately, opinions expressed by expert panels are not wholly congruent either. Guidelines[59] issued by the Board of Directors/Clinical Guidelines Task Force of the American Society for Parenteral and Enteral Nutrition indicate that GRVs should be checked frequently when feedings are initiated and that feedings should be held if residual volumes exceed 200 mL on 2 successive assessments. A more liberal view was expressed in the consensus statement[39] of the North American Summit on Aspiration in the Critically Ill Patient; this panel suggested that GRVs greater than 500 mL signal the need to withhold feedings and reassess tolerance. The panel further indicated, "GRVs in the range of 200 to 500 mL should prompt careful bedside evaluation and initiation of an algorithmic approach to reduce risk; even though GRVs less than 200 mL seem to be well tolerated, there should be ongoing evaluation of aspiration risk." A third set of guidelines,[60] published in 2003, indicated that the risk for aspiration is increased if GRV is greater than 200 mL. If such a GRV is present, the recommendation is that the feeding regimen be reviewed.

Prokinetic Agents

Because prokinetic agents (metoclopramide and erythromycin) increase gastric emptying, they are often used to maintain feedings into the stomach. Metoclopramide stimulates gut motility by antagonizing dopamine and sensitizing the gut to acetylcholine.[61] Erythromycin increases gastric motility by acting on motilin receptors in the gut; it also increases lower esophageal sphincter tone and esophageal peristalsis.[61]

Benefits. The efficacy of prokinetic agents has been evaluated by many investigators. For example, Pinilla et al[62] found that intolerance for enteral feeding was reduced by mandatory administration of metoclopramide when a GRV was 250 mL or greater. Jooste et al[63] showed improved gastric emptying after the intravenous administration of metoclopramide in a group of critically ill patients. Berne et al[64] found that tolerance to gastric feedings in 34 critically injured patients was significantly greater after the intravenous administration of erythromycin. In another study,[65] critically ill tube-fed patients who received erythromycin had greater success with enteral feedings than did a group of control patients (90% vs 50%, respectively). A single dose of metoclopramide reportedly improved gastric emptying in a group of 40 ICU patients with enteral feedings.[66]

Possible Adverse Effects. Unfortunately, prokinetic agents are not without risk. Metoclopramide has been associated with tardive dyskinesia, cardiac arrest, and elevated intracranial pressure.[67-69] Erythromycin has been associated with nausea, vomiting, stomach cramping, and risk for antibiotic resistance.[70,71] Erythromycin may also be associated with risk for sudden death from cardiac causes, especially when given with medications that inhibit the effects of cytochrome P-450 3A isozymes.[72] The risk-benefit ratio of using prokinetic agents should be decided on an individual basis.[73]

Zaloga and Marik[61] suggested that only patients who are intolerant of gastric feedings (defined as residual volume >150 to 250 mL) should receive a prokinetic agent.

Tube Characteristics and Gastroesophageal Reflux

Tube size apparently has no significant effect on gastroesophageal reflux and microaspiration in critically ill patients.[4,74] Although some studies[3,75] indicate that gastrostomy feedings are associated with less aspiration than are nasogastric or orogastric feedings, others[4,76] refute this finding. Most clinicians agree that the major reasons for using gastrostomy feedings are increased comfort for patients and fewer mechanical problems.[75,77]

Supine Position

Evidence That the Supine Position Increases Aspiration

Investigators[78-80] who used radiolabeled enteral formula showed that aspiration of gastric contents occurs to a significantly greater degree when patients are in a supine position than when in a semirecumbent (45° backrest elevation) position.

A low head-of-bed position was also identified as a significant risk factor for aspiration in a study[4] of 360 critically ill tube-fed patients receiving mechanical ventilation who were followed up for a period of 3 days. Almost 62% (n = 223) of the 360 patients had mean head-of-bed elevations less than 30°; these patients aspirated significantly more often than did patients with mean head-of-bed elevations of 30° or more ($P = .02$). Almost 94% (n = 338) of the 360 patients had mean head-of-bed elevations less than 40°; these patients also aspirated more frequently than did patients who had mean head-of-bed elevations of 40° or more ($P = .02$).

Expert Panel Recommendations

On the basis of available data, expert panels[38,39,45] have called for a head-of-bed elevation of 30° to 45° (unless contraindicated by the patient's medical condition) to prevent aspiration and aspiration pneumonia in critically ill patients receiving mechanical ventilation.

Frequency of Use of Head-of-Bed Elevation in Clinical Settings

Several studies[4,81,82] have indicated that critically ill patients often have head-of-bed elevations less than 30°. Although a low elevation may be used for valid reasons (eg, an unstable cervical spine or pelvis, unstable hemodynamic status, use of an intra-aortic balloon pump, or low cerebral perfusion pressure), often it is not. This finding raises a question about why an elevated head-of-bed position is not used more fully in practice settings. In a study[83] of 93 critical care clinicians, reasons cited for underuse of a head-of-bed elevation included poor understanding of the value of elevating the head of the bed to prevent aspiration and pneumonia, an assumption that other healthcare providers are responsible for prescribing or implementing head-of-bed elevations, and fear of causing pressure ulcers. Only intensivists and dietitians were aware of the potential benefits of having the head of the bed elevated. Nurses who were surveyed thought that underuse of a semirecumbent position is primarily due to the lack of physicians' orders specifying this position; in contrast, physicians reported that the main determinant was nurses' preferences. These findings highlight the need for healthcare professionals to mutually decide and agree when an intervention should be implemented. Of course, the appropriateness of a head-of-bed elevated position must be evaluated on an ongoing basis because contraindications may fluctuate as a patient's condition changes.

Research-Based Methods to Increase Use of a Head-of-Bed Elevated Position

Although a patient's positioning is largely under the control of the patient's bedside nurse, physicians also play a large role in assuring that elevation of the head of the bed is appropriately implemented. For example, an evaluation[84] of the effect of standard written medical orders for elevating the head of the bed in a population of critically ill patients resulted in significant improvements. The percentage of patients with a head-of-bed elevation of 30° or greater increased from 26% at baseline to 88% after the intervention; further, the percentage of elevations of 45° or more increased from 3% to 28%. Other methods to increase the use of elevating the head of the bed should be explored.

Conclusion

Microaspirations of gastric contents are common in critically ill tube-fed patients and are a major risk factor for pneumonia; interventions to reduce aspiration therefore may reduce the incidence of pneumonia. One intervention is preventing the delivery of feedings or medications via improperly positioned tubes. Another is increasing nurses' skill level in placing feeding tubes in the small bowel when indicated. Although clinicians agree that large GRVs predispose patients to aspiration, little agreement exists on the definition of "large." Therefore, no firm research-based rules are available to guide practice; until such information is available, clinicians are advised to consider the guidelines issued by the expert panels. A relatively simple intervention (at least in theory) to minimize aspiration is to elevate the head of the patient's bed to a minimum of 30° (unless contraindicated). In summary, nurses can play a major role in reducing aspiration and its adverse pulmonary effects in critically ill tube-fed patients.

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