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Perspectives

Recovery Strategies From the OR to Home

CEs for Nurses

Prevention of NG Tube Misplacement: Nursing Practices

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In today's health care environment, patient acuity and mean age are on the rise. One result of this trend is the increased use of enteral (tube) feeding for critically ill patients. Clinicians are often challenged to establish and maintain temporary feeding access via nasal or oral-gastric route without high risk of misplacement.

Safe placement of temporary feeding access has traditionally relied on clinical exam during the procedure (overt signs of airway placement) and then radiographic confirmation of tube position before feeding is initiated. Additional tools have been developed to guide the clinician and enhance safety during and after the procedure. These include capnography, evaluation of aspirated fluid, and newer techniques such as virtual imagery. An "old" test showing new promise is pH determination of tube aspirate. This method can be employed during the insertion procedure or at any time while the tube is in place, for routine nursing assessment or if misplacement is suspected. Paul Merrel and our panel of experts discuss the best practices for the safe insertion of the feeding tube.

As America ages, hospitals are increasingly serving patients with higher acuity and more complex health needs. Invasive interventions for such patients are often required as part of these patients' care plans. Interventions may involve continuous monitoring devices, intravenous catheters for hydration and medication, urinary catheters to permit close monitoring of urine output, and often some form of tube placed in the gastrointestinal (GI) tract. Enteral tubes can be used for a variety of clinical purposes, including administering nutrition and medications or performing gastric decompression.[1] In particular, the trend toward higher patient acuity has led to an increase in the use of enteral feeding for nutritional support of patients with complex conditions.[2]

Multiple uses for GI access

The need to empty the stomach may be associated with intractable nausea and vomiting (related to illness or some type of GI obstruction), or it may be done simply as a peri-operative precaution for patients undergoing prolonged general anesthesia. The most versatile and commonly used tube for this is a Salem sump tube, constructed of clear PVC or silicone and often inserted via nasal or oral route for gastric decompression. Salem sump tubes in 16 or 18 French are typically used for this purpose in adults. Stomach contents are evacuated by connecting the tube to an external suction device; the output is assessed for volume and character of aspirate. When appropriate, a normal saline solution may be instilled for gastric lavage, such as in cases of GI bleeding. Patients who have had abdominal surgery or trauma may have such tubes in place for several days, until adequate GI motility returns.

In the emergency department, this type of tube also provides a route for giving patients activated charcoal to adsorb ingested toxins. Salem sump tubes of various diameters may also provide a route for administrating medications when the patient can't safely take them by mouth. More prolonged reasons for NPO status include stroke, head injury, weakness from prolonged illness, or the need for intubation and mechanical ventilation. This last scenario is common with patients admitted to the ICU, where some form of sedation is often administered to help the person tolerate ventilatory support. A Salem sump tube may initially be placed for gastric decompression, and then used to administer medications and/or feedings when the patient requires ongoing mechanical ventilation.

When a person is NPO and needs medications that have no intravenous substitute, GI access is necessary for appropriate treatment of enteral forms of medications. These same patients are also likely to need nutritional support by the enteral route for some period of time.[3] The benefits of providing early feeding to hospitalized patients are well known, including improved immune response, lower incidence of infections, and shorter hospital stays.[3] As with any intervention, early [enteral] feeding also includes potential risks that must be managed carefully.[4,5]

Considerations for tube feeding

Most patients who require enteral nutrition can tolerate gastric feeding. The stomach is the logical place to instill nutrients when oral feeding is not an option. The exception to this is a functional or anatomic reason to question the patient's tolerance of gastric feeding. For example, if the patient must be maintained flat in bed due to traumatic injury or hemodynamic instability, the risk of refluxing and aspirating stomach contents increases.[6] Severe gastroparesis, pyloric obstruction and/or demonstrated intolerance to oral or gastric nutrition are other factors that make post-pyloric (small-bowel) feeding a safer option that can avert potentially life-threatening pulmonary complications. Feeding in the distal duodenum has been shown to reduce the incidence of pneumonia by as much as 18% compared to gastric feeds.[7] For patients diagnosed with pancreatitis, the feeding tube is usually po-

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Panel Discussion

Verification of Feeding Tube Placement: *Opinions from the Experts*

Moderator: **Paul Gilbert,** MD
Panelists: **Gregory Jurkovich,** MD
Jadie Dayton, RN, MPH, CPH,
Joe Krenitsky, MS, RD

Is the placement of a nasogastic (NG) feeding tube a high-risk procedure? If so, what are some of the risks to the patient both during and after placement?

Jurkovich: The placement of a nasogastric tube can be a high-risk procedure, particularly in an uncooperative patient or one who isn't mentally clear and competent. During insertion, the back of the nose or the pharynx can be injured, creating bleeding or a tear in the pharyngeal mucosa. Worse, the tube can go down the trachea and cause bleeding, pneumonia, or tearing. Or you can injure the esophagus or stomach, but that is less common unless the patient has an underlying esophageal problem. When a patient is awake, communicating, and cooperative, they can tell when something is wrong; but when the patient is unconscious, sedated, or comatose, the risks are magnified.

Krenitsky: According to studies of unguided (blind) placement of a nasogastric feeding tube, 1–2% of all placements enter the airway undetected.[1-4] Between 0.3–1.2% of patients had pulmonary injury, and 0.1–0.5% of deaths were due to misplaced small-bore tubes using this method. Pulmonary injury or death from unguided feeding tube placement occurs only in a small percentage of patients who actually receive these tubes, but the large number of tubes placed each year translates into a large number of injuries and deaths.[5] Sinusitis and nasal erosion are generally considered potential complications of longer term nasogastric tube use, although in the ICU population, sinusitis from nasal tubes may contribute to nosocomial pneumonia. Epistaxis from feeding tube placement is normally mild or self-limiting in patients who have no coagulopathy.

Dayton: The placement of an NG feeding tube is a high-risk procedure that requires the order of a healthcare provider and cannot be delegated to nursing assistive personnel. The placement of an NG tube for feeding requires highly accurate verification of the position of the tube to prevent complications. During the procedure, there is a risk for aspiration if vomiting occurs during the insertion. There is also a risk for improper placement of tube into the tracheobronchial tree or intracranial cavity. If a stylet is used for placement, there is a risk for penetration of mucous membranes. Finally, there is a risk of transmission of microorganisms. After placement of an NG feeding tube, there is a risk of aspiration of formula into the tracheobronchial tree, leading to the potential for necrotizing infection, pneumonia, and abscess formation, and also a risk of GI-borne infections.

What methods can be used during the insertion of a nasogastic feeding tube to decrease these risks? How is using a combination of multiple confirmatory methods helpful?

Jurkovich: For the awake and alert patient, it is best to put them in an upright sitting position and ask them to swallow the tube into the correct position. You can anesthetize the nose and passageways with a local anesthetic so there is less likelihood of pain that may cause the patient to make sudden movements. You can go slowly and gently and ask the patient to help. Patient cooperation removes almost any possibility of problems happening. For the unconscious patient, there is more risk. You must know the anatomy; the esophagus is posterior to the throat so you need to go smoothly through the pharynx and into the esophagus. Once you are in the esophagus, there should be no resistance—you should never force the tube during insertion. Resistance is a sign that you are pushing the tube into the wrong location. Finally, once you've reached the measured distance between the nose and the stomach, you need to confirm that it is in the right place This can be done either clinically or radiographically. In the first [clinical] method, air is blown into the tube and the clinician listens for the sound of air entering the stomach. This is not very specific nor sensitive, but this is how it has traditionally been done. Secondly, one can aspirate the tube and test the pH of the fluid to confirm that it is gastric fluid. Thirdly, one can confirm placement with radiography.

Krenitsky: Feeding tube insertion guided by fluoroscopy, direct laryngoscopy, or endoscopy is effective for prevention of tube misplacement, but these methods are costly and resource expensive. Having only experienced or dedicated personnel perform tube placements appears to reduce malposition of feeding tubes, however it does not eliminate it.[6] Clinical assessment of feeding tube position may be useful, such as listening for air passage after placing the tube to 25–30 cm, or placing the end of the tube in water and looking for bubbles.[7] Methods such as a double radiograph technique (i.e., one film with tube positioned at 25–30 cm, and the second after full advancement), CO_2 detection, and electromagnetic visualization of feeding tubes have been reported to decrease injury from malposition of feeding tubes.[2,5,8] Limited data exists on the combination of techniques to reduced tube misplacement or injury from feeding tubes. The only studies to have shown elimination of misplaced feeding tubes used a method to detect tube malposition after the tube was positioned at 25-35cm, along with the use of a dedicated tube placement team.[2,5]

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>
> - Dayton -

Dayton: To decrease these risks, the patient's mental status should be assessed prior to insertion, since alert patients are more likely to expectorate any vomitus that occurs during insertion. Proper hand hygiene and clean gloves should be used to reduce the risk of transmission of microorganisms. Positioning the patient in a high Fowler's position and having them swallow water or ice chips will also help guide the NG tube into the correct position while reducing the risk for aspiration by closing the airway during insertion. To

reduce improper tube placement, a variety of measures may be used. These include (a) correctly estimating the length of tube to be inserted (from end of nose to ear to xyphoid process), (b) promoting tube flexibility for large-bore tubes and correct use of stylet for placement of small-bore tubes, and (c) using multiple methods to confirm placement such as palpation, auscultation, pH testing, and chest X-ray. Using a combination of these multiple confirmatory methods is helpful in ensuring that the NG tube is in the desired location before commencing enteral feedings. Chest X-ray is the most accurate method of tube placement, followed by pH testing.

What are some of the benefits of using pH test strips to check the pH of aspirate? What are some of the drawbacks?

Jurkovich: Gastric fluid is the most acidic fluid in the body; so if the pH of the aspirate is very acidic, that confirms the tube has been placed in the stomach. The advantage of this method is that the confirmation is more reliable than with a clinical examination alone; plus, it saves the expense of radiography and avoids unnecessary exposure to radiation. The disadvantages are that the pH of the stomach fluid can be buffered or neutralized by a combination of medicines the patient might be taking. For example, the pH may not be as confirmatory for a patient who is taking medicines to block stomach acid production, such as, antacids, proton pump inhibitors, or H_2 blockers.

Krenitsky: One potential benefit of pH testing is that it has the potential to provide more real-time feedback for the position of feeding tubes. A pH < 4 is strongly indicative of gastric position; however, a pH > 4 has a low specificity. The accuracy of pH testing can be limited by the use of antacids or by reflux of duodenal contents into the stomach.[9] If a small-bore tube is advanced far enough along to obtain fluid before checking the position of placement, pulmonary injury may have already ensued.

Dayton: The benefits of using pH test strips include the fact that it can be done without delay at the bedside and it does not require a large amount of aspirated fluid to perform the test. A pH of 0–4 is a consistent indicator of gastric placement, more accurate than auscultation of air through the tube, visualization of the fluid, or palpation of the tube. However, pH testing also has its drawbacks. For example, as Joe suggests, the pH may be more alkaline if the patient has recently taken H_2 blocker, a proton-pump inhibitor (PPI), or has already been given a tube feeding. Also, pH testing must be delayed 1–2 hours after any oral or tube medication administration.

> One can aspirate the tube and test the pH of the fluid to confirm that it is gastric fluid.
>
> - Jurkovich -

Finally, testing exposes the healthcare provider to bodily fluid, and sometimes it is not possible to obtain fluid even after multiple attempts.

Should the pH of aspirate be checked even if the patient is on H_2 blockers or PPIs?

Jurkovich: There is no good answer to this question. These medications do "wear off" over time; but it could be that you may be placing the tube at the time of peak acid reduction, so you will not get the level of acidity to confirm placement. Also, the medications may not completely neutralize the pH, and you will still get some acidity. I'm not sure to what degree the pH will change when using these medications.

Krenitsky: In individual patients, a distinct change in pH of aspirated fluids may be an indicator for a change in tube position. pH testing may also be useful to verify the effectiveness of acid suppression therapy.

Dayton: Because the pH of a patient on H_2 blockers or PPIs is likely to be higher than 4 (rendering it similar to the pH of pleural fluid or nasointestinal fluid), measurement of pH may not be as useful for verifying the placement of an NG tube. However, if NG placement has been verified by chest X-ray, a pH measurement may still have value for evaluating the effectiveness of these medications.

Is the placement of a nasogastric suction tube also a high-risk procedure? As in the first question, what are some of the risks both during and after placement?

Jurkovich: The risks are the same as with a feeding tube; but the feeding tube is generally smaller and more flexible, so it is actually easier for it to be inserted into the wrong place, i.e., the trachea. Often a guidewire is placed in the lumen of the suction tube to give it more rigidity and help guide placement. The guidewire is removed after insertion and before the tube is used for feeding.

Krenitsky: There are limited data regarding the risks of placement of large-bore tubes. A larger bore nasogastric tube for evacuating gastrointestinal secretions can be misplaced into the bronchopulmonary system. However, placement of larger bore tubes appears to have a reduced likelihood of pneumothorax, in part because the tubes cannot pass into the small bronchioles.[6] However, pulmonary malposition is still possible if the tube position is not confirmed prior to use. Epistaxis may be more likely with stiffer large-bore tubes, and nasal erosion is more frequent with NG tubes maintained in position for extended periods.

Dayton: The risks during placement of a nasogastric suction tube are generally the same as for an NG feeding tube; however, as my colleague have indicated, those tubes have a larger bore and may be more difficult to place. This can be ameliorated with the use of lubricating jelly. After placement, risks related to the introduction of feeding formula into the lungs are eliminated, although risk for aspiration of gastric contents still remains. One risk that is unique to NG suctioning is the irritation of the gastric mucosal lining with incorrect suction level or frequency.

What methods can be used to diminish the liklelihood of a misplaced nasogastric suction tube?

Jurkovich: Again, it is much the same as for a feeding tube. If the patient is awake, you have them swallow the tube; this removes almost all risk. If they are unconscious or comatose, you just have to be very gentle when inserting the tube and not push when you reach an obstruction. Leaving the guidewire in will help as you insert the tube toward the posterior of the pharynx so that it enters the esophagus.

Krenitsky: Carbon dioxide detectors or colorimetric CO_2 detectors are useful for reducing the likelihood of injury from inadvertent placement of NG tubes into the airway during placement, and a double radiograph technique or electromagnetic detection may eliminate malposition into the airway. pH testing has a positive predictive value if gastric pH is < 4. Radiographic confirmation of final tube position should be obtained if CO_2 detection or pH testing is utilized, especially if there is the possibility that a tube used for suction may be used for medication or feeding administration in the future.

Dayton: Again, the use of multiple methods to confirm placement such as palpation, auscultation, pH testing, and most importantly, chest X-ray, will diminish the likelihood of misplacement. Additionally, the nurse can visualize the fluid in the collection chamber to evaluate whether

the appearance resembles typical gastric aspirate. Finally, regular assessment of the patient for abdominal distention, a change in the length of the exposed tube, or a change in the quality/quantity of gastric aspirate may serve as a tool to evaluate whether the NG tube has become dislodged.

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Prevention of NG Tube Misplacement —Continued

sitioned past the ligament of Treitz (distal jejunum) to avoid pancreatic hormone stimulation and disease exacerbation.[8]

Placing GI access

Temporary GI access for nutrition may be via the nasal or oral-gastric route. Placement of enteral access can be done in most settings by nurses or physicians, as well as a growing number of registered dietitians. If a larger Salem sump tube is already placed for gastric aspiration, it may be used; but softer, small-bore tubes designed primarily for tube feedings are preferable. These come in a variety of sizes and models; 10 or 12 French is the usual choice for adults. While the exact materials and exit hole designs are brand-specific, and they typically contain a thin wire stylet to add rigidity for directional control during the insertion procedure. Because the tube is relatively soft and small, it is usually well tolerated even by patients who are starting to resume an oral diet but still require supplemental feeding. This is a common situation because many patients who start to eat after prolonged illness initially lack the strength or appetite to consume sufficient nutrition by mouth.[9]

Tube insertion follows these general steps: (1) select a tube, (2) determine the distance for insertion, (3) position the patient semi-upright if possible, then (4) insert the tube and advance it gently to the correct position. The distance for insertion is determined by placing the tip of the tube at the patient's nare (or corner of the mouth), laying the tube along the route of insertion (on the face, neck and chest), and measuring the distance from patient's nose to ear lobe to the tip of the xiphoid process. This approximates the length of tube needed to reach the stomach, and this distance should be clearly marked on the tube. During insertion, the clinician slowly and gently advances the tube, while asking the patient to swallow as the tube advances. The clinician watches the patient for any signs of distress or intolerance[2] until the measured mark is reached. This technique usually works well if the patient can cooperate and follow directions.

Nearly all small-bore tubes and some Salem sump tubes now carry centimeter markings along the device, starting either 10 or 25 cm from the proximal tip. This feature, when used properly, provides a useful guide as to how far the tube is inserted and approximates [anatomically] where it may be at any point during the procedure. For those experienced with tube placement, the centimeter markings are an essential part of monitoring progress through the naso/oropharynx, past the epiglottis into the esophagus and then into the stomach.

At several points in the procedure, manipulation of the tip (changing the insertion angle, rotating the tip) may be necessary to advance the device; the markings help determine the best action based on anatomic "depth." Distance (by marks) to both gastric and potential post-pyloric placement is relatively predictable.[10] In the author's experience, the marks provide a guide to correlate with clinical assessment indicators as the clinician advances the feeding tube to the desired final position. Always record the marking at the nare or lip at the time of insertion when a confirmatory radiograph is obtained, to document external tube landmarks for comparison to subsequent assessments.

Challenges of Tube Placement

Regardless of the specific feeding device chosen, each presents the same challenge for the care providers: the need to insert a tube by "blind" technique. This means that, during the procedure, the clinician must rely on manual "feel," observation of the patient's response, and use of anatomic landmarks to determine clinically where the tube is placed. After the tube's desired location is confirmed by X-ray, verifying that it stays there also requires further bedside use of "blind" assessment steps. These skills (discussed in the following paragraphs) require practice and careful observation to provide safe and effective patient care.

Risks, Signs and Symptoms of Tube Misplacement

Safe placement of temporary feeding access has traditionally relied on clinical observations during the procedure (primarily looking for signs of airway placement), followed by radiographic confirmation of tube position before feeding is initiated. The clinician inserting a tube looks for coughing, change in voice quality, overt respiratory distress, air coming through the feeding tube or, in the ICU environment, change in oxygen saturation or triggering of ventilator alarms. Any of these signs is reason to withdraw the tube and let the patient recover before trying again.

Although such clues to tube misplacement are usually obvious, it is possible to insert a tube into the trachea or bronchial tree with little or no overt signs of trouble.[11] Illness, injury, or other interventions may affect the patient's alertness, increasing the risk of inserting the feeding tube into the trachea instead of the esophagus.[12] If protective reflexes (gag/swallow, cough) fail, airway placement may be "silent;" and the clinician might advance the tube far enough into the pulmonary tree to cause lung injury.

Many hospitalized patients lose some

of the effectiveness of their normal protective reflexes, such as coughing with airway invasion. Contributing factors are numerous: sedating medications, other invasive tubes already in place, altered mental status, and use of topical anesthetic for the procedure (which decreases sensation). In these cases, the clinician may fail to recognize more subtle signs of misplacement. Critically ill patients have been shown to have a high incidence of aspirating gastric contents, and this is a major risk factor for pneumonia.[13]

Usual practice is to have the alert patient swallow at the point the tube should be passing the epiglottis and going down the esophagus. The clinician may not properly time the advancement with swallowing, or a cough may be mistaken for the patient gagging with tube movement. Less experienced staff may try to finish the procedure quickly out of concern for the patient. Unfortunately, this haste likely increases the chances of unrecognized airway placement. It is better to proceed carefully, allowing pauses for the patient to "recover" as often as necessary. This also lets the clinician better assess and interpret the patient's response as an indicator of where the tube is placed. The risk of tube malposition is the safety rationale for confirming tube placement with an X-ray before instilling medications or nutrition.

Dislodged tubes

Additional problems with tube positioning may occur as well. Any patient with altered mental status may partially or completely dislodge the tube at any time, and bedside staff may inadvertently pull the tube out of place during routine care activities. Techniques for securing the tube to the patient vary (e.g., tape or an adhesive device designed for securement), but no measure completely prevents the tube from being pulled loose. Bedside clinical findings to assess when the tube is dislodged include external markings, auscultation of insufflated air and character of aspirated gastric contents. However, these indicators (discussed in the following paragraphs) are not always accurate predictors of the tube's location.[14]

Methods to improve safety, accuracy of placement

The need to initiate nutrition support while avoiding complications is clear. To ensure placement accuracy, various methods have been developed to facilitate placement of feeding access in the desired anatomic location.

Tube markings

Tube placement and maintenance of its position are why nearly all small-bore tubes and some Salem sump tubes now carry centimeter markings along the device, as noted previously. These can help indicate that the tube is staying where it was originally placed.

RightSpot Ph Indicator (Dale Medical Products, Plainville MA)

Auscultation

Nursing practice has traditionally included the auscultatory method of checking tube placement. This involves listening over the epigastrium with a stethoscope to evaluate the sound of air injected via the feeding tube. It is possible to mistake the sound of air in the esophagus or respiratory tract for gastric sounds, so this method alone is not reliable to confirm initial tube placement.[15-17] It may still have utility, though, as one means of confirming that tube position has not changed since initial position was confirmed radiographically.

Fluid aspirate exam

Examination of any fluid aspirated via the feeding tube is another useful, though not definitive test. This observation should always be correlated with the tube's depth (by landmarks) when the fluid is obtained. Any aspirate obtained within the first 30 to 40 cm may contain oral saliva, pulmonary secretions that have been coughed up, or even refluxed gastric contents. Appearance of secretions is at best a gross indicator. Clear to whitish, yellowish, or even brownish secretions could be from any site; and viscosity ("thick or thin") is also not specific. Even blood-tinged fluid can be from any orifice, due to trauma from tube insertion or other local irritation. The only finding likely to be helpful is the presence of clearly greenish or bile-stained fluid that is aspirated from a tube advanced to a depth of at least 50 cm. Even this could be aspirated fluid from the pulmonary tree rather than a true gastric fluid sample.[18] In any of these cases, visual observation alone is only useful in context and as evidence favoring—not proving—tube location. As with auscultated air, observation of fluid aspiration is more useful as a routine part of assessing a tube already confirmed in place, especially when bedside observation is correlated with the latest chest or abdominal film. Such correlation can be done verbally during team rounds, or simply by reading the radiologist's most recent radiographic report on that patient's tube position.[6]

pH testing

One "old" test showing new promise is pH determination of tube aspirate. Typical fasting gastric secretions have a pH of < 5, while the pH of small-bowel aspirate should > 6.[6,19] Pulmonary secretions also have a pH > 6, often ≥ 7.[20] Although many patients are on medications (H_2 receptor antagonists or proton pump inhibitors) to prophylactically elevate gastric pH, there is still usually enough difference in aspirate from these different sites to help confirm tube position. The clinician simply uses a syringe to aspirate fluid from the tube, and then uses pH paper (widely available in rolls or strips) to determine the sample's acidity. This method can be employed during the insertion procedure (when gastric depth is reached) or any time while the tube is in place—for routine nursing assessment or if displacement is suspected. However, it should not be done during tube feeding administration, as liquid feedings may buffer the gastric pH and skew the readings.[21] Position, type and size of the tube may alter the ability to aspirate any fluid for testing; but, by insufflating a small amount of air and then carefully aspirating, the clinician can usually obtain enough sample for testing. A pH clearly in the gastric range (< 4.5) is sufficient evidence to verify tube placement in the stomach. Similarly, a pH change to > 6 for a tube *already confirmed* in the stomach probably indicates the tube tip is now in the small bowel. In either case, pH testing has the potential to preclude or reduce the need for X-rays to revalidate the feeding tube's position.[20]

Over the last decade or more, federal regulations for the CLIA (Clinical Laboratory Improvement Amendments) program have made bedside pH testing less common, due to additional quality control and documentation requirements regarding "waived tests" (including pH testing).[22-24] In response, some patient care units stopped routine bedside testing for gastric pH and occult blood in stools—and opted instead to send such specimens to the central clinical lab when those tests were needed.[25] Fortunately, new devices for pH testing have increased the convenience of this bedside assessment.

One product (RightSpotpH Indicator: Dale Medical Systems; Plainville, MA) offers a compact, disposable device that can be attached to the proximal end of a feeding tube. The clinician uses a sy-

ringe to aspirate fluid through the indicator, thoroughly wetting the enclosed pH test strip. If the resulting color matches the color sample provided on the package, a gastric pH (< 4.5) is confirmed. If the colors don't match, repeat testing or a confirmatory X-ray may be indicated. Either way, the clinician gets useful information promptly with a simple device costing much less than the X-ray that might otherwise be needed.[26] When paired with a practice of checking the tube's location "marker" and patency every four hours, this device offers a way to routinely assess feeding access placement.

Capnography

Assessment for exhaled carbon dioxide (CO_2) is a simple, rapid way to determine tube misplacement in the trachea. This technology originally was developed for monitoring patients on mechanical ventilation, then later was adopted for short-term use with feeding tube insertion. The original and more complex method for this test utilizes a capnograph, a monitor that analyzes exhaled gas and provides both digital and waveform displays of the CO_2 level. It requires a disposable sensor, a cable, and the monitor.[27]

When using CO_2 measurements during placement of enteral access, it is only necessary to determine the presence or absence of CO_2 at the appropriate point during tube insertion. A device with this capability (Nellcor Easy Cap: Covidien; Mansfield, MA) was first developed as an adjunct to endotracheal intubation. It used a colorimetric paper sensor that changed from purple to yellow in the presence of exhaled CO_2, signifying placement of the breathing tube in the airway. Several years ago, this colorimetric technology was adapted for use in a smaller sensor designed to be placed on the end of a feeding tube during insertion (CO2nfirm Now; Covidien). The clinician first inserts the tube just past the 30-cm marking, far enough to be past the epiglottis. The sensor paper is attached to the main feeding port, and a small disposable bellow samples air through the tube's lumen. The clinician looks for any color change in the sensor.[14, 28,] There should be **no** significant CO_2 in the esophagus, so the sensor paper should remain purple (its original color). A "negative" readout indicates the clinician may continue advancing the tube into the stomach, while watching the patient for any symptoms.[16] If the sensor turns yellow, the tube should be pulled back to the 20-cm mark and then advanced again, with the CO_2 test repeated at ≈ 30 cm.

When this device is used as directed, the test is highly reliable in determining whether the feeding tube is in the esophagus vs. the trachea. However, AACN guidelines state that use of capnography "is not sufficiently sensitive and specific to preclude the need for a confirmatory X-ray before initial use of a feeding tube."

Guided placement

Another product with a more comprehensive approach to safety monitoring displays a virtual image of the feeding tube's insertion path during placement. This system (CORTRAK 2: CORPAK Medsystems; Wheeling, IL) utilizes electromagnetic signals to guide, track, and confirm tube placement. A transmitter is embedded in the tube's stylet; its signals are picked up by a receiver unit that the clinician positions over the patient's xiphoid process. A monitor triangulates the signals received to display real-time directional movement of the stylet. Using this unique device, the operator can safely place a tube in the stomach (or, with additional training, into the small bowel) and then print out a tracing to document the tube's position. The system also can show the tube deviating right or left higher up at the level of the carina, which demonstrates tracheobronchial placement and warns the clinician to pull back the tube before lung injury can occur. The CORTRAK stylet may be reinserted if the tube needs repositioning. The system is currently the only one of its kind that is FDA approved for confirmation of feeding tube placement, which can reduce the need for X-ray confirmation.[30,31]

The use of fluoroscopy (real-time X-ray imaging) is the definitive method for placing feeding access in a specific location. It is commonly utilized for small-bowel or post-Ligament of Treitz placement, when bedside attempts are unsuccessful. Fluoroscopy is also indicated when abnormal anatomy (congenital or post-surgical) or pathology makes it difficult to establish enteral access by usual methods.[19] While some tube placements require the use of fluoroscopy, it is expensive, labor intensive, and often requires the patient to be transported to a radiology suite. Transporting the patient can pose significant risks, particularly to ICU patients, including those on mechanical ventilation and/or other forms of life support. For these reasons, fluoroscopy should be limited to circumstances where its technical benefits are clearly needed. In most cases, the "gold standard" of X-ray verification of tube placement is adequate to confirm the tube is in the intended part of the GI tract. X-rays are readily available in virtually all hospital settings and are a widely accepted standard for expert evaluation of tube position.[32]

Limitations of methods to ensure placement accuracy

All the techniques and technologies described in this article have both advantages and limitations. Clinicians need to evaluate which combination of their available techniques and technologies offer the most accurate methods for evaluating accurate tube placement in the GI tract.

What is "best practice?"

All clinicians, whether nurses, physicians or dietitians, want to meet their patients' nutritional needs safely and consistently. The variety of feeding tubes, tube placement techniques, and daily management issues can make this task challenging. The best solution is always based on (1) an evaluation of each patient's unique needs, (2) a multi-disciplinary, collaborative approach to determining the best plan for delivering nutrition/medication, and (3) wise use of the products available to manage the nutrition plan. However, beyond that, there is broad agreement on the practices that minimize or prevent complications related to the feeding tube itself.[29,]

The American Association of Critical-Care Nurses (AACN) has issued practice alerts that provide a concise, comprehensive set of guidelines for practice steps to follow both during tube insertion and as part of ongoing bedside maintenance of enteral access.[29,33] Listed below are their consensus recommendations.

1. During the insertion procedure, use multiple clinical assessments:
   - Observe for signs of respiratory distress.
   - Perform capnography at the appropriate point, if available.
   - Observe any aspirate via the tube, and measure its pH if test strips are available.
   - Do not rely on air auscultation alone to decide if tube is in the GI tract.
2. Always obtain radiographic confirmation of the tube's location *before* instilling medications or nutrition via the tube.
   - Place an indelible mark on the tube adjacent to the lip or nare site, to provide a clear visual reference for the tube's position at the time X-ray was obtained.
   - Review the tube's position on all subsequent chest or abdominal films, to evaluate any change in location.
3. After feeding has begun, do the following checks at least every four hours:
   - Look for a change in length of the external portion of the tube; has the mark at the exit site moved?
   - Observe the volume and character of any aspirate from the tube; any changes?
   - If feedings are interrupted for several hours (for a procedure, due to intolerance, etc.) check

the character and pH of the aspirate; compare to previous results.

- If any of this evidence suggests the tube position has moved, consider obtaining a follow-up X-ray to confirm location.

Summary

Consistent use of these bedside assessment steps is the key to noticing any change in location or function of the tube as soon as possible. This early identification of potential risk for patient harm is a great way to avoid complications associated with feeding tubes. These steps can facilitate the desired outcomes for patient support and recovery.

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After reading this article, the learner should be able to:

1. Recognize the rationale for and risks associated with NG tubes.
2. Describe the devices available to enhance safety with temporary feeding tube management.
3. Identify the pros and cons of each method used for tube insertion.
4. Discuss the role and interpret the results of bedside pH testing on fluid aspirated via the feeding tube.
5. Outline recommended practices for safe management of feeding tubes.

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1. **Many techniques are standard for helping ensure correct NG tube placement and reduce risk of complications. Which one is not?**
   A. Have the patient swallow water or ice chips during the procedure.
   B. Perform a double radiographic technique.
   C. Use proper hand hygiene and wear gloves.
   D. Use multiple methods to confirm placement.
2. **If you have to manipulate the tip of an NG tube by rotating it or changing its insertion angle during initial placement, that indicates:**
   A. You need to withdraw the tube and start again
   B. The tube is in the patient's airway
   C. The patient has esophageal achalasia
   D. Nothing; that may be necessary to do
3. **The best way to mark the location of a small-bore feeding tube at the nare or lip is by:**
   A. Using a marker to show the location on the tube
   B. Recording the centimeter mark nearest to lip or nare
   C. Placing a piece of tape on the tube at lip or nare
   D. A or B
4. **Fluid aspirated via an NG tube has a pH of 6.5. This result indicates the tube is likely…**
   A. In the small bowel (post-pyloric)
   B. In the stomach
   C. In the patient's airway
   D. A or C
5. **Clinical signs that a feeding tube has been inserted into the patient's airway may include:**
   A. Coughing or gagging as the tube is advanced
   B. Air is heard coming through the tube
   C. No signs; the patient looks fine
   D. All the above
6. **Which of the following has the FDA approved as accurate enough to be used for confirming tube placement in lieu of getting a confirmatory X-ray?**
   A. Tracings produced from the transmitter in the stylet of the CORTRAK 2 system
   B. pH testing of fluid aspirated via the feeding tube shows a pH < 5
   C. Use of the CO2nfirm Now carbon dioxide detector
   D. Endoscopically assisted tube placement
7. **Which of the following is not a step in the general procedure of placing an NG tube?**
   A. Select a tube
   B. Determine the distance for insertion
   C. Place the patient supine or on one side
   D. Insert the tube and gently advance it to the correct position
8. **Which of the following may skew pH results of fluid aspirated to confirm gastric placement of an NG tube?**
   A. Recent administration of a proton-pump inhibitor
   B. A recent tube feeding
   C. Recent administration of an H_2 blocker
   D. All the above
9. **Unguided (blind) placement of a nasogastric feeding tube is not considered a high-risk procedure, so nursing assistive personnel may do it.**
   A. True
   B. False
10. **You should always get an X-ray before starting feedings through a tube, but it's OK to give meds while you wait for confirmation.**
    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. Recognize the rationale for and risks associated with NG tubes.	1	2	3	4	5	6
2. Describe the devices available to enhance safety with temporary feeding tube management.	1	2	3	4	5	6
3. Identify the pros and cons of each method used for tube insertion.	1	2	3	4	5	6
4. Discuss the role and interpret the results of bedside pH testing on fluid aspirated via the feeding tube.	1	2	3	4	5	6
5. Outline recommended practices for safe management of feeding tubes.	1	2	3	4	5	6

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Questions

Mark your answers with an X in the box next to the correct answer

	A	B	C	D
1	☐	☐	☐	☐
2	☐	☐	☐	☐
3	☐	☐	☐	☐
4	☐	☐	☐	☐
5	☐	☐	☐	☐
6	☐	☐	☐	☐
7	☐	☐	☐	☐
8	☐	☐	☐	☐
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