Administering Medications via Feeding Tubes: What Consultant Pharmacists Need to Know

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Drug-nutrient interactions, tube occlusion, and other complications can result when certain medications are given through a feeding tube. Here's an overview of what to look for to prevent these complications while providing optimal drug therapy to residents fed through a tube.

Since the end of the 16th century, patients who have not been able to eat have been receiving "nutritional mixtures" through a hollow tube into their gastrointestinal tract. The exact number of patients receiving tube feedings in long-term care is not available; however, a 1992 estimate reported about 150,000 patients and this number is growing with the aging population. The guidelines for use of tube feeding (also called enteral nutrition) include patients in whom oral feedings are not possible or are inadequate to maintain their nutritional status. This can include patients with a variety of diagnoses such as dementia, cerebrovascular accident, upper gastrointestinal (GI) obstruction, or trauma. Unfortunately, this group also usually need medications to treat their primary conditions as well as secondary conditions, which poses a problem when the patient cannot receive oral medications.

The primary goal of medication administration in patients who are tube fed is to maximize the therapeutic response to the medication without adversely affecting enteral nutrition delivery and tolerance. This is best accomplished using a multidisciplinary approach with the consultant pharmacist, nursing staff, staff dietitian, and physician involved. Knowledge of the medications, feeding tube characteristics, nutritional formulas, and specific procedures of the nursing staff are needed as well as the medical history of the patient. Key to the successful delivery of the nutrients and medications is prevention of complications such as tube occlusion and drug-nutrient interactions.

Types of Feeding Tubes

Generally in long-term care, more permanent feeding tubes are in place; however, that may not always be the case. Occasionally, short-term or temporary tubes called "nasoenteric (nasogastric or nasointestinal) tubes" are used for brief periods of less than three to four weeks. These tubes are generally small-bore (8-12 French) and made of polyurethane or silicone. They are low in cost and easily placed at the bedside but can be uncomfortable, easily dislodged, and more easily occluded than tubes designed for long-term use.

Long-term feeding tubes can be classified into two types, those placed with the feeding tip either into the stomach (gastrostomy tubes) or into the jejunum (jejunostomy tubes). They are placed using various methods including endoscopic, open surgical, laparoscopic, or radiologic techniques. Feeding tube names and abbreviations are often used interchangeably and sometimes incorrectly. Not every tube, for example, is a PEG (percutaneous endoscopic gastrostomy) tube, and the pharmacist and nursing staff (registered nurses, licensed practical nurses, and trained medication aides) must learn what type of tube has been placed in the patient including the size, material, brand, and tip location, and which physician inserted the tube.

Gastrostomy tubes are generally 12-30 French, are made of polyurethane or silicone, and have a balloon, mushroom tip, or disc to secure them internally. The external portion has a disc or bumper at the skin level, an end adapter that links with the feeding bag tubing, and often a side port for medication administration (see Figure 1).
Jejunostomy tubes are inserted either directly into the jejunum or through the stomach and passed through the pylorus into the small bowel. (see Figure 2). They are placed when it is desirable to bypass the stomach, as in those patients with upper GI obstruction or those at high risk for aspiration. The tube sizes are 8-24 French and are composed of polyurethane, silicone, or rubber. Adapters are often placed on the end of the tube to aid in feeding, flushing, and medication delivery.

Pharmacologic Concepts

The important concepts to understand for optimal medication delivery via a feeding tube include nutrient-drug incompatibilities, drug dosage forms that can or cannot be given through feeding tubes and specific drug-nutrient interactions.

Nutrient-Drug Incompatibilities

All dosage forms have the potential to cause incompatibilities administered to the tube-fed patient. The types of incompatibilities are physical, pharmaceutical, physiologic, pharmacologic, and pharmacokinetic. Physical incompatibilities result in an actual physical change when substances are combined. The end-result is usually a precipitate (curdling) or a change in viscosity (thickening or separation). Physical incompatibilities often cause feeding tubes to occlude. Pharmaceutical incompatibilities occur when there is an alteration in the drug form itself that interferes with drug efficacy, potency, or tolerance. Medications in certain dosage forms such as enteric-coated or sustained-release should be evaluated by the pharmacist to determine whether the form of medication may be changed prior to delivery into a feeding tube. Physiologic incompatibilities occur as a result of a non-pharmacologic action incurred by the medication itself or by the medium in which it is suspended. This incompatibility often occurs when liquid medications have a high osmolality or have a high sorbitol content. Patients can develop diarrhea from these medications if given undiluted. Pharmacologic incompatibilities occur when a medication alters tolerance to the tube-feeding regimen, such as diarrhea related to generous use of prokinetic agents. Pharmacokinetic incompatibilities refer to changes that can occur with bioavailability, absorption, distribution, metabolism, or excretion of the medication. For example, impaired absorption of phenytoin that results from tube feeding represents a pharmacokinetic incompatibility.\textsuperscript{3,6}

Drug Dosage Forms that Can Be Administered

Medications that can be administered via enteral tubes include immediate-release oral tablets, soft gelatin capsules, and liquid medications. Soft gelatin capsules filled with liquid can be given by punching a pinhole in the capsule and squeezing out the contents.

Liquid medications are the best alternative for administration via a feeding tube because of decreased risk of tube clogging and better absorption of the medication. However, they can cause physiologic incompatibilities such as GI distress. Often patients are labeled as tube-feeding intolerant when the distress is likely medication-related. The intolerance is attributed to either a high osmolality of the medication or to large amounts of sorbitol required for medication formulation. Liquid medications up to 6,000 mOsm can be found, whereas GI tract secretions are 300 mOsm. Unless diluted, the GI tract will pull water into the lumen to dilute this high osmotic load and cause osmotic diarrhea. This is especially true when the medication is delivered directly into the small intestine via a jejunostomy tube.

These complications can be avoided by diluting the liquid medications with an appropriate amount of water. The formula below can be used to calculate the exact amount of water needed to bring the osmolality down to isotonic levels:

\[
\text{Final Volume} = \frac{\text{Volume of liquid med}}{\text{Osmolality of med}} \times \text{Osmolality of water}
\]
Then subtract the volume of liquid medication from the final volume to determine the final water volume to use for dilution. For example, a dilution of 30 ml of water can reduce a 10 ml amount of medication with an osmolality of 2,000 mOsm/kg to 500 mOsm/kg. It is recommended that all liquid medications be diluted with at least 30 ml of water when the patient's fluid status allows.

**FIGURE 1. Percutaneous Endoscopic Gastrostomy in Place**

![Percutaneous Endoscopic Gastrostomy in Place](http://www.ascp.com/publications/tcp/1999/jan/tubes.shtml)

It is important to consider the patient's clinical status when calculating additional free water needs, as some patients may be unable to tolerate the large volumes of water needed for multiple medications. Many tube-fed patients do not receive adequate amounts of water in the tube-feeding formula. They may need additional flushes and tolerate liberal amounts of fluid used to dilute their medications. A general rule for water requirements is to give 35 ml/kg of body weight per day. Lists of liquid medications with their osmolality level and sorbitol content can be found in a variety of references. Examples of medications that are often cited to be problematic include acetaminophen elixir, theophylline solution, and potassium chloride liquid. Medication suspensions have few compatibility problems but may be hypertonic and need dilution. Antibiotics are often in this form and may be associated with diarrhea, but it is often the antibiotic and not the dosage form that contributes to this problem.

**Drug Dosage Forms Not Recommended to Be Administered via Feeding Tube**

Crushing of enteric-coated medications can induce pharmaceutical incompatibilities, and alternative therapeutic equivalents or administration routes should be considered. Enteric coating provides protection to the lining of the stomach as in the case of enteric-coated aspirin. This coating also protects the integrity of the medication from destruction in the acidic environment of the stomach. Once the medication moves into the alkaline environment of the small bowel, the enteric coating dissolves and the medication can be absorbed. An example of this type is pancrealipase. Other medications that should not be administered via a feeding tube include sublingual or buccal medications, sustained-release tablets or capsules, and syrups. Acidic syrups hold a high risk of
physical incompatibility when mixed with enteral formulas and often lead to tube clogging. A classic example of this is iron elixir.

**Drug-Nutrient Interactions**

A few medications that have been studied are clearly influenced by enteral formulas. Drug-nutrient interactions apply to any situation in which incompatibility involves changes in medication bioavailability, absorption, distribution, metabolism, or excretion. Impaired absorption of phenytoin is a pharmacokinetic incompatibility and is well documented in the literature.\(^1\)\(^,\)\(^2\) There appears to be an impairment in absorption, but the exact mechanism has yet to be defined. Possible reasons for this interaction include the protein source in the enteral formula (calcium caseinate) binding the drug, binding of the drug to the feeding tube, and poor solubility of the phenytoin itself and thus poor absorption. Phenytoin doses may need to be increased in tube-fed patients in order to maintain therapeutic blood levels. One strategy to promote optimal therapeutic levels is to hold the feeding two hours before and after the phenytoin dose and adjust the tube-feeding schedule to meet nutritional requirements; dilute the phenytoin with 30 ml of water to enhance solubility and improve absorption, and monitor blood phenytoin levels carefully, especially if the patient is changing tube-feeding regimens or moving from the parenteral to the enteral dosage form.\(^1\)\(^,\)\(^2\)

Resistance to warfarin has been documented in case reports and is believed to be related to the vitamin K content of formulas.\(^13\) Subsequently, enteral formulas have been re-formulated to contain only small amounts of vitamin K (between 10 and 75 mcg/l).\(^14\) Even with these small amounts of vitamin K in the tube feeding, adequate anticoagulation can still be a problem. It is helpful to maintain stable and consistent formula delivery to facilitate accurate medication dosing. Formula delivery can be adjusted by holding the feeding one to two hours before and after the warfarin dose in order to increase absorption. The pharmacist needs to monitor anticoagulant activity closely while the patient is receiving tube feedings and to evaluate warfarin dose, anticoagulation goals, and parameters closely as the patient transitions to an oral diet.\(^15\)

**Medication Administration Procedures**

Written guidelines for medication administration can provide nursing staff with clear steps to take to avoid tube occlusion and to optimize therapeutic response of the medication. Table 1 describes a procedure for medication administration. General rules for delivering medications via enteral feeding tubes include the following:

- Use the oral route if at all possible.
- If the tube must be used, use liquid medications.
  - Flush the tube before and after the medication is administered with 30 ml of water.
  - Dilute liquid medications with at least 30 ml of water to decrease osmolality.
  - Avoid mixing any medications with the feeding formula.
- If liquid medications are not available, check to see that the tablet medication can be crushed.
- Administer each medication separately to avoid drug-drug incompatibilities, and flush the tube well between with 15-30 ml of water.
- Consider the timing of the medication; check to see whether it should be given on an empty or full stomach.
- Provide exact information about tube location to the dispensing pharmacist in order to best provide the correct dosage form. Use only water to flush tubes, as cranberry juice or cola may actually promote tube occlusion.

**TABLE 1. Step-by-Step Procedure for Administering Medications through a Feeding Tube**

1. Verify tube placement.
Tube Occlusion

Tube occlusion or clogging is one of the most frequent complications of enteral nutrition. In one study of jejunostomy tubes in 44 patients in nursing facilities, 27.3% of patients had tube occlusions. Occlusions in general can be caused by inappropriate administration of medications, poor flushing techniques, thick formulas, or reflux of gastric or intestinal contents up into the tube. The change in pH from digestive enzymes mixing with the formula's intact protein in the tube tip causes protein denaturation and thus a clog in the tube. Ideally, to prevent occlusion, flush the tube with 20-30 ml of water before and after checking for residuals and administer medications or intermittent feedings every four to six hours. Many nurses use a variety of flush fluids to prevent clogging or to restore patency for occluded tubes such as cranberry juice and carbonated cola beverages. These liquids are acidic and may actually contribute to tube clogging from protein denaturation. Water has been shown thus far to be the best flushing solution. Other clogging prevention measures include the following: choose the appropriate size tube to maximize formula flow; select a less calorically dense formula; use a feeding pump with an automatic water flush feature, and do not mix medications with the formula.

If the tube does become occluded, immediate attention to the clog is important. The first step is to check to see whether the feeding tube is kinked. Place the flushing syringe into the tube end and gently pull back on the plunger to dislodge the tube. If the blockage remains, instill warm water into the tube. Gentle pressure alternating with suction will relieve most obstructions. The tube can also be milked with the fingers from the insertion site out.

A successful technique of declogging includes instillation of a pancreatic enzyme and sodium bicarbonate solution, as described by Mancuard et al. A few noteworthy products to unclog tubes are now available such as the Intro-Reducer (Health Improvement Associates, Freeland, MI) and the Declogger (Bionix, Toledo, OH); these are thin plastic devices to clear the clog. Another product combines a thin catheter and chemical declogging powder to be put into solution and instilled into the clog via the catheter, and has met with success as well (Clog-Zapper, Corpak Medsystems, Wheeling, IL). Prior to using any of these devices or products, the pharmacist should be sure that the pharmacy practice act or clinical privileges allow for such procedures.

Role of the Consultant Pharmacist

It would seem obvious that the nursing staff should know how to properly prepare and administer medications via feeding tubes.
medications through feeding tubes; however, two recent surveys of nursing practice demonstrate otherwise. In a study by Seifert and colleagues, 223 RNs and LPNs who worked in a variety of health care settings reported that 50% of feeding tube obstructions were caused by medications. Even though 97% of the nurses perceived that medications given in a liquid form decreased clogging and 94% made an effort to seek liquid-dose forms, only about 55% of the time did they use that dosage form; the rest of the time crushed tablets were used.

Assistance from the pharmacy department did influence administration practices. Nurses who received assistance were significantly more likely than nurses who reported no pharmacy assistance to administer liquid forms (62.1% versus 41.9%, p < 0.001) and were less likely to administer medications that needed to be crushed (43% versus 64.5%, p < 0.001). Nurses who reported pharmacy assistance also reported significantly fewer feeding catheter obstructions due to medications. The survey also reported that 78% of nurses crushed and administered an enteric-coated dosage form and 50%, a sustained-release dosage form. Also only 69% of those surveyed flushed the feeding tube with water prior to medication administration, only 59% diluted liquid medications, and 57% delivered several medications together.

In a more general survey of nursing management of enteral tube feedings, Mateo found similar results with regard to flushing the tubes: 47% reported flushing the tube before medication delivery and 38% flushed between medications. These two surveys clearly identify areas in which the consulting pharmacist can provide educational programs, medication review, and quality improvement activities.

Summary

Consultant pharmacists have an opportunity to provide cost-effective educational opportunities and medication profile supervision for health care professionals administering medications to patients receiving tube feeding. By maximizing the therapeutic response to medication and preventing occlusion of the drug delivery access, the patient receiving enteral nutrition will have optimal feeding outcomes.

References


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