Considerations for Drug Administration through Enteral Feeding Tubes

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Introduction
Enteral nutrition (EN) through a tube is the preferred method of feedings for patients with a functional gastrointestinal (GI) tract but who are unable to receive adequate nutrition from oral intake. This can be a very beneficial option for patients in regard to cost, decreased infection risk and maintenance of a functional GI tract. EN tubes can also be used to deliver medications.1,2 This article will address considerations and challenges of drug administration through an EN tube. The recommendations which follow are based on the most recent American Society for Parenteral and Enteral Nutrition (ASPEN) guidelines as well as evidence-based guidance from the published biomedical literature.

Type of Tubes and Frequency of Feeding1-4
It is important to consider what type of tube and the frequency of feedings that a patient will be using. Feeding tubes are classified by their insertion site (nasal, oral or percutaneous) and the location where the tube ends (stomach, duodenum or jejunum). Nasal and oral tubes are generally only used for short periods of time, typically less than 3 to 4 weeks, while percutaneous tubes are used for long-term therapy, over 4 to 6 weeks.

The feedings may also be given over a variety of frequencies, such as continuous, cyclic, bolus or intermittent. Continuous feedings are given at a slow consistent rate over 24 hours. Cyclic feedings are similar, but are typically given overnight and turned off during the day to encourage oral feeding or to allow the patient freedom from feeding machinery during the day. Bolus feedings most closely match oral feeding patterns and are small infusions given typically 4 to 6 times a day. Intermittent feedings are similar to bolus, but the time of the infusions is slightly longer to improve the patient’s tolerance.
Size of the Feeding Tube¹,²,⁴
The next item to consider is the size of the feeding tube and how that may affect selection and administration of medications. EN tubes are either small- (5-12 French) or large- (≥14 French) bore tubes. Either small- or large- bore tubes may be used for medication administration, but small-bore tubes have a greater chance of becoming clogged. Because of this, it is recommended to administer only liquid medications via small-bore tubes.

Large-bore tubes may be used for suction in some patients. If this the case, the tube should be clamped for at least 30 minutes following medication administration to allow for absorption before suction is restarted.

Placement of the Tube¹-³
The placement of the distal end of the feeding tube, and how it may affect the absorption of various medications, should also be considered. Whether the tube is placed in the stomach, duodenum or jejunum can affect how medications are absorbed:

- Medications, such as antacids, bismuth and sucralfate, act directly in the stomach and will have little effect in patients whose tubes end in the small bowel.
- Medications that undergo extensive first pass metabolism, such as beta-blockers or opiates, will have greatly increased absorption if they bypass the stomach and are released in the jejunum.
- Certain medications, such as ketoconazole, require an acidic environment to be absorbed properly, and will have decreased bioavailability if they are used with a tube that ends past the stomach.

Any of these issues may require a dose adjustment or the selection of a therapeutic alternative.

Appropriate Dosage Forms and Flushing¹,²,⁵
The appropriate dosage form and how to flush the EN tube is an important consideration. When available, a non-oral dosage form, such as a transdermal or rectal formulation, may be preferable to EN tube administration.

If drugs are to be administered via the EN tube, the tube should be flushed with 10 to 30mL of sterile water before and after each medication. Drugs should not be mixed together, but given separately with the tube being flushed with 5 to 10mL between each medication.
Guidelines from ASPEN recommend that the EN tube be flushed with 15mL of water prior to medication administration; that the drug be diluted and administered in an oral syringe containing at least 30mL; and that the tube be flushed again with 15mL of water after each medication is administered.

**Administering Liquid Medications**\(^4,2,3,6\)

If an oral dosage form must be administered via EN tube, it is best to use a liquid formulation in most cases. There are some concerns with liquid formulations, however. Liquid preparations tend to only be available as an immediate release formulations and will require more frequent dosing if they are being used to replace an extended release product.

If the liquid medication is hyperosmolar, it must be diluted in 10 to 30mL of sterile water to prevent the patient from experiencing osmotic diarrhea. The osmolarity of liquid products can be found in the product’s package insert. Another cause of diarrhea is sorbitol, an excipient used in many liquid formulations of drugs. Sorbitol can cause cramping and diarrhea in amounts over 15mL daily, and the concentration of sorbitol may differ among different manufacturers of the same drug. Suspensions generally contain the least amount of sorbitol, but may be more viscous than other formulations. This decreases the ability of the medication to be used in smaller tubes.

To ensure optimal drug absorption, suspensions should be shaken well before administration. In general, suspensions are the preferred liquid formulation, along with elixirs. Syrups tend to have a pH ≤4 and can cause enteral feedings to thicken and clump, in turn clogging the EN rube. It is best to avoid syrups for this reason; if syrups cannot be avoided, the feeding should be stopped and the tube should be flushed with at least 30mL of sterile water before and after the syrup is administered.

**Administering Solid Dosage Forms**\(^4,2,3,7\)

If a liquid formulation is not available, it may be appropriate to crush a compressed powder tablet or open a hard gelatin capsule. The powder or contents of the capsule should be mixed with 15 to 30mL of sterile water prior to administration. Liquid-filled gel caps may be pierced at one end with a needle. The liquid may then be squeezed out and mixed with water. However, there is a concern that this could result in subtherapeutic dosing if all of the medication from the gel cap cannot be removed.
Crushing may only be done with immediate release products. Extended release tablets and enteric-coated, sublingual or buccal products should not be crushed as these forms may not be absorbed properly. Extended release capsules should not be crushed, but if they contain microencapsulated pellets, the intact pellets may be administered through a large-bore tube.

Carcinogenic, teratogenic or cytotoxic products should also not be crushed because of the risk to the healthcare worker from the aerosolized powder. The Institute for Safe Medication Practices maintains a list of oral dosage forms that should not be crushed. The current version is available at [http://www.ismp.org/tools/DoNotCrush.pdf](http://www.ismp.org/tools/DoNotCrush.pdf).

**Drug-Nutrient Interactions**¹,²,⁴

The next item to consider when administering medications via EN tubes is whether there are any drug-nutrient interactions. Common drug-nutrient interactions, as well as recommendations for managing these interactions, appear in Table 1 on the next page.

It is also important to consider whether a medication needs to be given on an empty stomach. If this is the case and the EN tube ends in the stomach, the EN feed should be held for 30 minutes before and after drug administration.

**Additional Resources**

The ASPEN Enteral Nutrition Recommendations are available [here](http://www.ismp.org/tools/DoNotCrush.pdf) [journal subscription may be required]. Medication administration is addressed in Section VII. These guidelines were endorsed by the American Society of Health-System Pharmacists and the Institute for Safe Medication Practices.

*The Handbook of Drug Administration via Enteral Feeding Tubes* was updated in 2015 and is a worthwhile investment for practice sites which frequently administer medications via feeding tubes. The Handbook contains information on over 400 drugs, with specific strategies for safe and effective administration via enteral feeding tubes.
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<tr>
<th>Drug Name</th>
<th>Interaction(s)</th>
<th>Management</th>
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| Carbamazepine             | May adhere to tube (mechanism unclear)                                        | • Dilute suspension with equal volume of sterile water or normal saline  
  ■ Alternately, mix the capsule contents with 15mL of water  
  • Monitor levels and patient’s clinical response closely |
| Esomeprazole              | Destroyed by gastric acid                                                     | • Mix capsule contents or suspension with water                                                                                                                                                    |
| Fluoroquinolones          | Binds to multivalent cations \(\text{Ca}^{2+}, \text{Mg}^{2+}, \text{Al}^{3+}, \text{Fe}^{2+}\); Suspensions adhere to feeding tubes | • Avoid use of suspension; ciprofloxacin tablet is the preferred formulation  
  • Crush tablet and dilute with 20 to 60mL of water  
  • Hold feeding 1 hour before and 2 hours after  
  • Consider higher end of dosage range, as bioavailability is reduced |
| Lansoprazole              | Destroyed by gastric acid; Suspension blocks feeding tubes                   | • Avoid use of the suspension due to viscosity and size of the granules  
  • Mix capsule contents with apple/orange juice and flush with juice, or  
  • Dissolve granules in sodium bicarbonate 8.4% solution, or  
  • Mix orally disintegrating tablet with water |
| Omeprazole                | Destroyed by gastric acid                                                     | • Mix capsule contents with apple/orange juice and flush with juice, or  
  • Dissolve granules in sodium bicarbonate 8.4% solution |
| Omeprazole/Sodium Bicarbonate | Destroyed by gastric acid                                                    | • Mix with water  
  • Hold feeding 3 hours before and 1 hour after |
| Pantoprazole              | Destroyed by gastric acid                                                     | • Mix suspension with juice |
| Phenytoin                 | Adheres to tube; Binds to proteins and calcium salts                          | • Use the liquid preparation when possible  
  ■ Alternately, crush the chewable formulation or give the total daily dose by making a slurry with phenytoin ER capsules  
  • Dilute with 20 to 60mL of water  
  • Stop feeding and flush tube 2 hours before dose  
  • Hold feeding for 2 hours after dose  
  • Monitor levels and patient’s clinical response closely  
  • Very high doses may be needed |
| Tetracyclines             | Binds with divalent cations                                                   | • Hold feeding 1 hour before and 2 hours after |
| Warfarin                  | Binds to proteins                                                            | • Hold feeding for 1 hour before and after dose  
  • Monitor PT and INR closely  
  • Dose may need to be increased |

Table 1. Common Drug-Nutrient Interactions

1,2,4,8
Tube Obstruction

The final problem that can affect drug administration via EN tube is obstruction. Clogging can occur for a variety of reasons, but is something that must be addressed in a timely manner. A recommended first step is flushing the tube with warm water. If this is unsuccessful, an alkalinized enzyme solution can be used. This solution can be prepared by mixing the following ingredients in 5mL of water, and administered via the tube:

- 1 crushed pancrelipase tablet (lipase 8,000 units, amylase 30,000 units, protease 30,000 units)
  - Alternately, 1/4 teaspoon of pancrelipase powder may be used.
- 1 crushed non-enteric-coated sodium bicarbonate 324mg tablet
  - Alternately, 1/8 teaspoon of baking soda may be used.

Summary

Feeding tubes designed for enteral nutrition can be used to administer medications in many circumstances. Small-bore tubes should only be used to administer liquid medications, in order to reduce the risk of obstruction. In general, suspensions are the preferred formulation for tube administration, but viscous suspensions may still clog small tubes. When obstruction occurs, tubes should be flushed with warm water or an alkalinized enzyme solution.

In addition, feeding tubes should be flushed with 15mL of water before and after drug administration. Drugs delivered through feeding tubes should be diluted to at least 30mL. In some cases, a break from feeding may be necessary to avoid drug-nutrient interactions.
References