Understanding Drug-Nutrient Interactions in tube-fed patients

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Memorial Sloan-Kettering Cancer Center
Research Pharmacy
Mark G. Klang, MS, RPh, BCNSP, PhD
Introduction

• Few drugs are tested for feeding tube route
  – Fewer are tested for exit site below stomach
  – However FDA is increasingly aware of the feeding-tube route
    – Teva’s ODT lansoprazole because it clogged FT.
    – (generic drugs retain package insert of trade-name, but lack studies supporting use and formulation)
FT Administration Perspectives

Clear Oral Liquids: Preferred *(to avoid clogs)*
- Suspensions are thick – need dilution to dissolve

Plain Tablets: Crush & Flush
- Some have coated shells which do not crush well
- Some drugs are poor water solubility and may fall out of solution when mixed with water – mix in syringe

Hard Gelatin Capsules: Open, Mix (powder), & Flush.
Soft Gelatin Capsules: Create pinhole and extract into syringe or squeeze into feeding tube. (Nifedipine)
This does not work for many liquid-filled capsule. The volume of liquid inside is very small- easier with two holes in capsule
Acidic drugs form clogs

• Standard nutrition clogs when passing into stomach
  • Acidic drugs will form clogs inside feeding tube
  • Depending on rate – clogs formation can be faster (<50 mL/hr)

• Liquid medications (syrups) are prone to clogs
  • Ferrous Sulfate Elixir is worst offender (Niferex is an alternative)

• Solid drugs can also react – Plavix, Aspirin
Physical Issues - Clogging

• Products that clog tubes: DO NOT USE in feeding tubes!
  – K Dur Tablets
  – Biaxin Suspension
  – Phenytoin capsules – Mylan (solid interior)
  – Cipro Suspension
  – Vancomycin Capsules (solid interior)

** Not a good source of Magnesium – yet is routinely ordered and forms clogs

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• Magnesium Oxide **
• Metamucil (Benefiber ok)
• Dyazide
Pharmaceutical Issues:
Crushing Extended Release Drug Products
  • Destroys Extended Release properties
  • Increased risk of side effects and toxicities

Example: Trental Tablets

<table>
<thead>
<tr>
<th></th>
<th>Intact Tab</th>
<th>Crushed Tab</th>
</tr>
</thead>
<tbody>
<tr>
<td>C$_\text{max}$</td>
<td>184 ng/mL</td>
<td>1789 mg/mL</td>
</tr>
<tr>
<td>t$_\text{max}$</td>
<td>2.25 hr</td>
<td>0.6 hr</td>
</tr>
<tr>
<td>S.E.</td>
<td>none</td>
<td>Nausea, dizziness, diaphoresis, vomiting</td>
</tr>
</tbody>
</table>

• But – Make a liquid form, by crushing and mixing with water – give a lower dose, more frequently.

Cleary et al. *AJHP* Aug 1999; 56:1529
Proton Pump Inhibitors
(Prilosec, Prevacid, Nexium, Zegerid)

• Acid-labile enteric coated dosage form
• Three methods of gastric feeding tube administration: *
  1. Flushing of intact granules with water (clogs easily)
  2. Administration of intact granules with fruit juice
     • Draw 30mL juice into syringe and flush FT – need about 120 ml total to give drug
  3. Use NaHCO₃-based suspension for Post-Pyloric
     – Does not apply to Protonix – solid tablet
     – Does not apply to Zegerid (already contains NaHCO3)

PPI (Prevacid) - ODT

• Orally Dissolving Tablet (ODT) – can be mixed with water 5-10 mL and work for gastric
  • Avoid ODT to get “under-the-tongue” absorption
  • Drug needs an intact GI tract to get drug to site of absorption
    • Although small pellets still forms clogs
• Also, AVOID mixing oral PPI capsule content with water – mixes better with acidic juice (apple juice is best)
  • The coating gets sticky when mixed with water
Holding Tube Feeding

• Major reason patients do not get goal nutrition is holding for drug administration
• Numerous reports – advise to improve absorption
  – Certification exams, textbooks articles
• Much is based on misconceptions of drug interaction and absorption
• Protein Binding – of drug to nutrition is cited
  – Many drugs bind to protein, but no change in absorption
• Interaction with activity – speculative based on animal research
• Drugs include Sinemet, Dilantin, Levofloxacin, Ciprofloxacin, Synthroid, Warfarin, Tegretol
% Drug Lost in Ensure compared to water

Wright et al. *JPEN* Jan/Feb 2000; 24: 42
Osmotic Issues

Common Side Effects associated with Enteral Nutrition?
  • 40% of TF Diarrhea caused by excipients
Diarrhea, Nausea, Vomiting, Cramping, Distention & Bloating
Is it caused by:
  • The Enteral Nutrition ??
  • The Drug Therapy ??
  • Both ??
MSKCC - Liquid Medications

- Selected 70 liquid medications
- Determined pH, Checked Osmolality
- Did a test to combine with Osmolite
  - Placed in incubate shaker at 37°C
- Some formed solid clogs in tube
- Passed through 100 micron screen
  - Several left hard granules
  - Article submitted to JPEN

If pH < 4.0 clogged. All vehicles form clogs
**Osmotic Issues**

Inadequate dilution of electrolytes

- 60 mEq KCl requires 6-8 oz of water per 20 mEq

Injectables provide dose in small volume

- Osmolarity >1000
- MVI injection ordered for feeding tube

Salt and sugar packets can be given if diluted.

- Several orders for IV dextrose and saline ordered.

Generic liquid Lomotil – contains sorbitol – oops!
Compounded Liquids for FT

- Many Pharmacies will prepare a liquid drug suspension only available as solid.
  - Few of these have been tested for stability.
  - Some have 0 effect as insoluble in water (these are best mixed inside syringe) (Emend, Spornox)
    - Look for co-precipitates i(povidone)
- USP have guidelines for about 100.
  - Literature has many more – many that USP rejected (all with flavoring were rejected)
  - Most use a combination OraSweet/OraPlus 50/50. Acidic sorbitol containing syrup

Advise staying with crushed tablet mixed in water
Crushing Syringe – Healthcare Logistics

Item Code: 7334-01
Description:
Crushing Syringe, 60mL
• Available individually.
• Can be used as a regular irrigation 60mL syringe as well as for crushing, liquefying and dispensing medication.
• Helps to insure administration of full dosage.
• Sanitary single patient use helps eliminate cross-contamination.
Product found on page(s) 684 of the Sand Piper Catalog.

Price: $1.90/Each

www.Healthcarelogistics.com
Crushing Syringe
Warfarin

• Nutrition Formulas were altered twice to reduce vitamin K content
• Presumed to bind to formula
  – Study used intestinal model at pH 8
• Holding tube-feeding will not alter effect of vitamin K or protein binding
• Drug binds to plastic
  – Minimize contact through rapid administration, rinses
  – Don’t expect any interaction with tube placed beyond stomach
• MSKCC policy – give same way every time. Check INR
Pancreatic Enzyme

FDA removed pancreatic enzymes from market

- All manufacturers must conduct new validation of efficacy
- Feeding tube unclogging requires sodium bicarbonate and immediate-release enzymes
- Coating must be removed to allow enzymes to work.
- Viokace now replaces Viokase: soon to be released
  - Different Manufacturer, ingredient amounts, and indications (But – IDENTICAL according to new manufacturer at same address as old one)
Pancreatic Enzyme study

- Six glass funnels were clogged with calcium caseinate and HCl
- Zenpep (15,000 units lipase) in 5mL of NaHCO₃, 37°C water bath (45 minutes to remove enteric coating – for 3 funnels)
- Warm water 5 ml for the other 3.
- Blue dye was placed as a marker of movement through the clog
6 clogs
Recommendations

Liquid Drug forms preferred

- If hypertonic, viscous, thick, dilute with 15-60mL water (3 times the volume)

Do NOT crush sustained-release drugs for one-time administration

Mix tablets / hard gelatin capsules with 10-15mL water

Most clogs are drugs
Recommendations (cont.)

Do not add drugs to container or formula
Continuous feeding stopped (0-30min.) and tube flushed with 15-30mL water
Administer each dose separately and flush with 3-5mL between doses
Flush tube with 15-30mL water after last dose (flushing also provides water for Sodium balance)
Questions?