



Notes from a Plumber's Helper—Clogs I Have Known (in Feeding Tubes)

Memorial Sloan-Kettering Cancer Center
Research Pharmacy
Mark G. Klang, MS, RPh, BCNSP, PhD
February 7, 2017 1-2






- › Nature of the beast
- › Sticky messes
- › **Slow movers**
- › Why doesn't dissolve?
- › Itsy bitsy pieces
- › Fun with Chemistry
- › Food for thought
- › Fizzies
- › Vibbbbbbration
- › Rinse and Rinse again



Nature of the Beast –

- › Intact protein reacting with low pH
 - Elemental and peptide based proteins don't react with acid
- › Undissolved Solids (drugs/ powdered nutrition/ blender feedings)
- › What Causes Clogs?
 - Inadequate fluid
- › Multiple insults coming together.
- › Tube design/ distal site/ internal size / kinks


Tube-Occlusion Module

- › Courtesy E. Frankel, C. Rollins
 - Checking residuals
 - Slow rate of Administration
 - Medication Interactions
 - Inadequate flushing
 - Tube Design
- › ASPEN module also suggested yeast?
 - Remove tube
 - Polyurethane better silicone
- › Antacid/ Sucralfate are reported to form clogs


Sticky Messes – checking residuals

- › Standard of many nursing protocols
- › Little justifications
- › Varies between individual patients/ practitioners
- › Causes aspirations, erosion of tubes
- › Gastric emptying is a function of feeding
- › (See ASPEN: *Safe Practices for Enteral Nutrition*)




Formulation Issues

- › Extended release drugs should never be given through feeding tube
 - Besides running risk of toxic effects
 - Form clogs.
- › Many formulations use wax-like PEG
 - Crushing wax matrix can release much higher amounts of drug
 - Slow Mag contains much more than written on label
- › Slower release is often due to coatings
 - Removing PPI coating make drug immediate re




Definite drug clogs

- › Products that clog tubes:
 - DO NOT USE in feeding tubes !**
 - Potassium Tablets
 - Clarithromycin (Biaxin) Suspension
 - Phenytoin - generic
 - Ciprofloxacin Suspension
 - Vancomycin Capsules
 - Psyllium fiber (Metamucil) – Benefiber dissolves
- › Suggest an alternative product



How Sweet it is!

- › Sugar coated shells/beads – provide acidic barrier
 - Mixing with water will become sticky
 - Mix with apple juice to keep beads intact
- › Some drugs sprayed onto sugar to enhance dissolution (Emend)
 - Drugs will precipitate if mixed separately
- › Mix all poorly soluble drugs in a syringe and make into a slurry. Give the mixture through the tube




Sugar makes the medicine go down

- › It also provides an acidic pH for reactions
- › Adds to higher osmolarity – causing diarrhea / cramping in intolerant patients
- › Adds to viscosity/ thickening of solutions
- › Keeps drugs suspended more evenly



Pharmacy Compounding


- › Pharmacists use Ora-Sweet Ora-Plus
 - Contains high sorbitol/ parabens.
 - Suggest Syr-Spend, lower osmolarity
 - Or 0.5% Carboxymethylcellulose
 - › Takes 1 day to mix from powder
 - Feeding-tube doesn't need sweeteners, flavors

Select Drugs with Enteral Nutrition Study

› Drug	pH	Osmolality	I/C
› Acetaminophen Solution	4.4	4035	I
› Acetaminophen Suspension	4.7	6425	I
› Acyclovir Oral Suspension	5.8	4205	I
› Aluminum Hydroxide Gel	7.2	1501	C
› Al(OH) ₃ , Mg(OH) ₂ , Simethicone	7.8	990	C
› Aminocaproic Acid Solution	6.2	3405	C
› Atovaquone Suspension	5.9	135	I
› Azithromycin Suspension	9.5	3950	I
› Calcitriol Solution	7.8	NA	I
› Calcium Carbonate Suspension	9.2	2490	C
› Carbamazepine Suspension	3.7	4225	I
› Cherry Syrup	2.8	6165	I
› Dexamethasone Intensole	3.9	10600	I
› Digoxin Solution	6.5	5950	C

Kiang M, Ng N and McLymont V. Osmolality, pH and Compatibility of Selected Oral Liquid Medications with an Enteral Nutrition Product. J Parenter Enteral Nutr. September 2013; 37: 689-694



Question: "In your experience, which medications have caused enteral feeding catheter obstruction?"

	% of Responders
① Sucralfate (Carafate)	31.3%
② Potassium Chloride tablets	27.9%
③ Theophylline tabs/caps	12.3%
④ Fiber (Metamucil)	12.3%
⑤ Phenytoin Tab	11%
⑥ Enteric coated medications	10.4%
⑦ Miscellaneous	29.2%

Seifert et al Clin Nurs Res 1995; 4:290-305



Avoiding clogs – by rinsing

- › Rinse with water
 - Some reports say pancreatic enzymes, other sodas, other cranberry juice.
 - Feeding tubes degrade with all the above
 - › Polyurethane are susceptible to lipid and strong acids
 - Nothing is superior to water to dissolve, clear or rinse
 - Juices, soda are acidic and makes clogs worse.

Pharmacy Student project

- Each student selects 10 oral formulary medication
- Each drug is examined for solubility / excipient issues
- The drug is crushed using nursing device
- The volume water needed to dissolve
- The pH of the final mixture
- The Osmolality of the mixture
- The amount of undissolved powder on 100 μ m sci
- If pH is under 5, check for compatibility with formula

Over 300 medications evaluated for potential FT administration

Predicting Clogging


- › Assumed that if drug particles were greater than 100 μ m, they would occlude the screen and would also clog a feeding tube.
- › Problem – **ALL** drugs tested left residue on screen.
- › Many completely clogged screen as they contain cellulose that is insoluble in water
- › Can an insoluble substance be given through a feeding tube without clogging?
 - If you dilute , mix well and rinse well

Thick as a brick



5 mg dissolved readily

Clogged syringe




Capsules do not dissolve



Hazardous drug

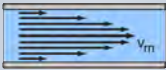
- › Do not crush or open capsule Chemotherapy
 - USP 800 advises respiratory N-95 mask, double-chemotherapy certified gloves, gown and BSC
- › Add drug to syringe and allow to dissolve in 15 ml Water.
- › Capsules take long time to dissolve
 - Injection can be given
 - Through tube
 - Etoposide, Cytosin



PPI's and feeding tubes (Lansoprazole, Omeprazole)

- › Pick one:
 - Open capsule, mix with juice, rinse well 60 ml - gastric
 - Mix capsule with sodium bicarbonate – gastric/jejunum
 - Use Orally Disintegrating Tablet (ODT) – mix with water 5-15 ml –gastric only
- › Avoid
 - ODT to get “under-the-tongue” absorption Needs an intact GI tract to get drug to site of absorption
 - Mixing oral capsule content with water – mixes better with acidic juice (apple juice is best)
- › PPI is one of most common drug clog reported
 - The beads adhere in water – avoid water
 - Never use tablet formulation – beads in stone

Slow movers


- › Avoid less than 50 ml/hr into Gastric
- › Laminar flow
 
- › Velocity along edge is slower
 - Allows for retrograde clog
 - The clog formed by reactions with migrating acid along walls

Why doesn't dissolve?

- › Solid Drugs don't dissolve readily when combine with nutrition
- › Reduce particle size – crushing solids
- › Suspensions are thick, add water to thin
- › To improve dissolution add more water
- › Surfactants improve dissolution
 - DSS (Colace) will allow mineral oil to be absorbed
 - Dangerous, as mineral oil will accumulate in lungs


Itsy bitsy pieces

- › To improve dissolution – crush thoroughly
- › Smaller particle, increased surface area
- › Adding more fluid reduces clogs.
- › Most drugs contain cellulose
 - Never dissolves
 - Thickens in acid
 - Expands extensively
 - Requires extra fluid to pass




Fun with Chemistry

- › Most Pharmaceutical liquids are acidic
 - React with nutrition
- › Drug clogs require acidic fluid to dissolve, but make protein clogs worse.
- › The jejunum is more basic than stomach.
 - Drugs must be dissolved first for absorption
 - Solid drug will not dissolve in jejunum as there is little fluid



Clogged Feeding tube



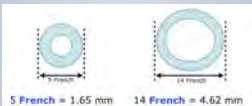
Dr Harvey tells me she saw CAR on a pink remnant inside a feeding tube

Optimal Feeding Tube

- Interior lumen size.
 - › 10 French minimum for solid drug administration.
 - › Ideal is 16 French
 - › Many studies used 16 French as model to state drug is safe for that route
 - › 8 French can only accommodate commercial liquid feeding formula. No Drugs or blenderized diets can be administered.
- › Poor Choice
 - Red rubber catheters. Clog easily, cracking common
 - Foley catheters contain latex, have no interior coating and have tip design that leads to clogging

Feeding tubes – Learning French

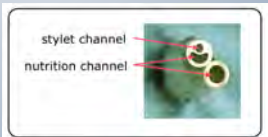
- › Size is important.
 - Wider (20 Fr) and shorter tube (PEG/PEJ) clog less



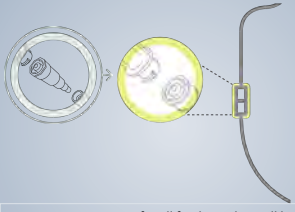
- › Tube design – distal port
 - Single exit is ideal, stronger flow
 - More exits – softer flow, more clogs

Tube issues

- › Only a designated feeding tube should be used for feeding
 - Avoid Foley's, urinary catheters, red rubber tubes
 - Hydromer coating can erode on tube, allowing more clogs
 - Avoid mercury weighted tubes
 - Never use tubes with leur-lock connections



Stay Connected 2014-5...? EnFit



New **ENFit** connector for all feeding tubes will be introduced this year. Special adapters will be available for first year, but must be phased out
www.StayConnected2015.org

EnFit Difference

- › A 24 French tube for Bolus has internal diameter 4.65 mm
- › Same size Enfit opening is 2.95 mm
- › For the very large tubes, there is reduced flow.
- › Majority of GI service is 20 French.
- › EnFit tube can vary small to large, but the EnFit opening is standardized.
 - Acts as a constriction. In theory interference is minimal

ISMP - Inaccuracies




Figure 8. Medication drawn up from a cup without an ENFit connector and dispensed by mouth. The volume of medication in the syringe tip at the start and end of administration is the same, so dosing is accurate.




Figure 9. Medication drawn into an ENFit syringe in the pharmacy using an ENFit adapter, and then given via an ENFit device. The volume of medication in the syringe tip is the same before and after administration, so dosing is accurate.




Figure 10. Medication drawn from a cup but administered into an ENFit device can lead to over-delivery of medication. The volume of medication in the tip of the syringe is less before and after administration. The full dose plus the extra in the dead space was administered.




Figure 11. Medication drawn into a syringe using an ENFit adapter but given to mouth leads to under-delivery of medication. The volume of medication in the tip of the syringe is less before and after administration. The dose minus the drug left over in the dead space was administered.

Dead-Space errors (ISMP)



Figure 1. New ENFit syringe (left) has larger female tip than an oral syringe with a male tip (right).



Figure 6. The ENFit syringe tip (circled) must be cleared when measuring doses and before connecting to an ENFit (male) feeding tube (left). If fluid remains, some leakage may occur and a small amount of extra medication may be administered.




Figure 7. Medication remains in the syringe tip if using an ENFit syringe to administer an oral dose.

Post Pyloric Administration

- › Feeding past pylorus reduces aspiration risk
- › Tubes are generally smaller than gastric and prone to clogging
- › Increase in number of PEJ/PEG Feeding tubes at MSKCC
- › Drug absorption completely different. Many drug require acid to dissolve.
 - If drug doesn't dissolve, it cannot be absorbed
 - Mix these drugs in acidic juice to dissolve first
- › Little clinical data available to guide choices

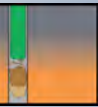
Food for thought

- › Intact protein – will react with acids to form clogs
- › Blender diet – press through cheesecloth to avoid clogs – leave out the walnuts/raisins
- › Fats congeal – dissolve with ethanol
 - Fat reacts with salt to form soaps
 - Oils react with Ca and Mg to form
- › Ethanol is a lubricant and dissolves li and poly-urethane tubes
- › Elemental diet – individual amino acids – require mixing, stink and have high osmolarity
- › Supplements are often powders that require extensive mixing to avoid clogs





Fizzies – agents to unclog tube

- › Mountain Dew, Club Soda, Coca-Cola, cranberry juice
 - All acidic – great to dissolve weak base drugs
 - Will make protein-based clogs worse
 - Sticky – strong acid – pH 3-4
- › Meat tenderizer, MSG, papain – no documented success
- › Best remedy – warm water
- › Dissolves everything – eventually
- › Biggest issue getting the agent to the clog



Pancreatic Enzymes

- Best documentation of success
- Most are Enteric coated – must remove coating with sodium bicarbonate and heat
 - › May take 30 minutes
- Viokase (Viokace) is only FDA approved agent for this use
- Need bicarbonate to activate enzyme
- May make clog worse
- Will erode silicone tube if over-used




Formula Issues

Review the enteral formula and its preparation

- Intact protein will form clog with acids
- Improperly mixed powdered formulas will form clogs
(This is a more frequent issue with pediatric and neonatal formulas.)

› **Blenderized foods may form clogs**

- › Check if foods used are appropriate for tube administration
- › This method of preparation is discouraged
- › Foods used in formula must be thoroughly blended for tube administration

Other clog removers

- › *Clog-Zapper™*, *DeClogger*
 - Requires introducer to get enzymes to site of clog
- › Failed remedies
 - Papain (meat tenderizer)
 - Carbonated beverages, cranberry juice



Vibbbbbbration

- › Tube-Clear sonication
 - Jack-hammer for your clog
- › Has an introducer taps on clog
- › Small vibrations can loosen clog. Maintain patency of tube
- › Safer than using brushes (only for PEG/PEJ)






Rinse and Rinse again

- › The best remedy to avoid the clog formation
- › Dissolve all medications with ample water
- › No lumps in food / even blenderized



Recommendations

- › Liquid Drug forms preferred
 - If hypertonic, viscous, thick dilute w/50-60mL water (3 times the volume)
- › **Do NOT crush sustained-release drugs**
- › 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

