CLINICAL PRACTICE

Pitfalls of administering drugs via nasogastric tubes

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Crushing tablets and opening capsules before administration via nasogastric or enteral feeding tubes is a widespread practice. A survey of nursing homes in the UK reported that more than 80% crush tablets on at least a weekly basis, and 40% of nurses crush tablets on every drug round.[1] In hospitals in Queensland, Australia, 104 different drugs were recorded as being altered at the bedside, with 84% of the drugs altered on a daily basis;[2] tablet crushing accounted for 75% of alterations.[2] However, data on the safety and efficacy of administering crushed tablets or opened capsules are limited. Patients may be harmed if the bioavailability of drugs is either impaired, resulting in reduced efficacy, or enhanced, resulting in toxicity. Mechanical failure of nasogastric tubes may also occur as a consequence of administering drugs. Finally, there are important medico-legal implications of administering altered oral drug formulations.

This article highlights the problems associated with administering drugs via nasogastric or enteral feeding tubes, and suggests ways of improving the safety of this practice.

Altered absorption

Enteric-coated tablets protect the active ingredient against degradation by gastric acid, and crushing these tablets will reduce the bioavailability of the drug. For example, omeprazole is a lipophilic weak base that is unstable at a low pH and is formulated in a gelatin capsule containing small enteric-coated granules that release the drug at a pH of >6.[3] Crushing these granules will expose omeprazole to the acidic gastric contents, reducing its half-life to less than 10 minutes at a pH of <4.[3] Some formulations, such as nitrates, may be sugar- or film-coated to protect against light and should therefore be administered immediately after being crushed.

Erratic drug concentrations may be caused by crushing controlled-release drug formulations. Decreased bioavailability of a sustained-release formulation of theophylline, which is likely to reduce efficacy, was observed when it was crushed and administered via nasogastric tube.[4] Enhanced bioavailability of a crushed sustained-release formulation of nifedipine has been demonstrated,[5] which is likely to increase toxicity, graphically illustrated by a case report of fatal cardiac arrest after a patient received crushed sustained-release nifedipine.[6]

Drug-enteral feed interaction

Flushing crushed tablets down the nasogastric tube with enteral feeds is a common nursing practice that may cause sub-therapeutic concentrations if the administered drug binds to the feed. Serum concentrations of phenytoin are reduced by 72% when it is administered with enteral feeds.[7] Phenytoin binds strongly to serum proteins, and it is thought that the decreased absorption of this drug when it is given with enteral feeds may be caused by binding to proteins in the feed. The bioavailability of crushed ciprofloxacin is also markedly reduced when it is co-administered with enteral feed,[8] probably owing to ciprofloxacin binding to divalent cations.[9] Enteral feeds should be withheld for 2 hours before and after administering drugs known to interact with feeds.

Mechanics of crushing – interactions and hypersensitivity

Crushing different medications in the same receptacle should be avoided owing to possible drug interactions. For example, the bioavailability of tetracycline is decreased when it is crushed together with iron supplements because of formation of poorly soluble tetracycline-iron chelates.[10]

It is important to clean the pestle and mortar properly before crushing tablets for the next patient to prevent hypersensitivity reactions, which may be triggered after exposure to a small amount of the drug allergen.

Binding to the nasogastric tube

Nasogastric tubes are made of polyvinyl chloride, and certain drugs (e.g. phenytoin[11] and carbamazepine suspensions,[12] and levothyroxine[13] and amiodarone tablets[14]) have been shown to bind to the wall of the nasogastric tube. Diluting the administered drug and irrigating afterwards with water, sodium chloride or dextrose will decrease binding to the tube.[12]

Tube occlusion

Administering crushed medication via a nasogastric tube may occlude the tube. Bulk-forming laxatives, such as ispaghula, form a semi-solid mass that may occlude the

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tube.[9] Cholestyramine, a bile acid sequestrant, and crushed gelatin-coated capsules, such as omeprazole, may also occlude nasogastric tubes.[15] Various approaches have been used to clear blocked tubes, but there is no evidence that any of these are more effective than flushing with water.[15]

Rate of gastric emptying

Gastric emptying may be delayed in critically ill or postoperative patients who require nasogastric tubes. Delayed gastric emptying will reduce the bioavailability of drugs that are either crushed and administered via nasogastric tube or taken orally. Paracetamol[16] and atenolol[17] were demonstrated to have significantly reduced bioavailability when administered as crushed formulations via nasogastric tube postoperatively compared with intact tablets preoperatively.

Medico-legal implications

Drugs are registered to be administered as particular formulations, and altering the formulation before administration renders their use off-label. Consequently the manufacturer will assume no responsibility for any harm caused to the patient by crushing tablets.[1] To minimise liability, the reasons why dose modification needed to be made should be clearly documented. Ideally evidence-based practice should be followed, but there are data supporting the safety of only very few drugs (e.g. antituberculosis drugs,[18,19] fluconazole,[20] linezolid[21] and moxifloxacin[22]). Importantly, nursing staff should not administer crushed tablets without authorisation, which is the responsibility of the prescriber. Despite the fact that unauthorised crushing of tablets exposes nursing staff to litigation, a study looking at medication errors in psychiatric inpatients found that unauthorised crushing was the commonest error encountered.[23] More worrying is the fact that 9.8% of nurses surveyed in nursing homes in the UK would not seek advice before crushing tablets.[1]

Guidelines for safer practices

Table I lists safer practices for administering drugs to patients with nasogastric or enteral feeding tubes.

Table I. Guide to safer administration of drugs via nasogastric tubes

General considerations
- Consider alternative routes of administration (e.g. rectal, subcutaneous, intramuscular)
- It is preferable to use commercially available suspensions rather than crushing tablets or opening capsules
- Consult a pharmacist or clinical pharmacologist
- Nurses should not crush tablets/open capsules without the authorisation of the prescriber

Enteral feed and tube management
- Stop the enteral feed and flush the tube with at least 30 ml water before administering the drug
- Flush between drugs with at least 10 ml water to ensure that the drug is cleared from the tube
- Withhold enteral feeds for 2 hours before and after drug administration for drugs with known interactions with feeds

Mechanics of crushing
- Use a porcelain or glass (not wooden) pestle and mortar to crush the drugs
- Do not crush different drugs together
- Mix the crushed drugs with 10 - 15 ml water to facilitate administration
- Thoroughly clean the pestle and mortar between different patients

Formulation-specific recommendations
- *Soluble tablets*. Dissolve in 10 - 15 ml water
- *Liquids/suspensions*. Dilute viscous liquids with an equal amount of water before administration
- *Tablets*. Do not crush enteric-coated or modified-release drugs. Mix with 10 - 15 ml water
- *Capsules*. If the capsule content is viscous, prick and squeeze contents into receptacle and mix with water

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