Pharmaceutical assistance in the enteral administration of drugs: choosing the appropriate pharmaceutical formulation

Assistência farmacêutica na administração de medicamentos via sonda: escolha da forma farmacêutica adequada

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ABSTRACT

Objective: To study solid medications for oral delivery on the formulary of Hospital Israelita Albert Einstein (HIAE), investigating the possibility of using these drugs through enteral feeding tubes, and recommending appropriate administration. **Methods:** Study carried out through survey of solid medications for oral delivery included on the formulary of HIAE, literature review, and analysis of medication monographs, manufacturer information and pharmacotechnical data of active ingredients and excipients. It was observed the factors that might hinder or complicate the administration of these drugs though enteral tubes, and was drawn an information chart with recommendations about drug administration in this context. **Results:** The study evaluated 234 medications; and the main problems of administering these drugs through enteral feeding tubes were as follows: changes in drug pharmacokinetics (38); gastrointestinal damage (9); risk of obstruction (40), drug-nutrient interactions (7); biological hazards (5) and no information (33). **Conclusions:** Compiling this information helps the healthcare team to choose the appropriate pharmaceutical formulation for medications administered through enteral tubes, and may help identify adverse events related to this technique.

Keywords: Pharmaceutical preparations/administration & dosage; Drug administration routes

RESUMO

Objetivo: Analisar os medicamentos sólidos orais padronizados no Hospital Israelita Albert Einstein (HIAE), de acordo com a possibilidade de serem administrados via sonda enteral e com as recomendações para administração adequada. **Métodos:** Estudo realizado por meio do levantamento dos medicamentos sólidos orais padronizados no HIAE e posterior análise da revisão da literatura publicada, monografia das drogas, informação do fabricante, e dados farmacotécnicos da forma farmacêutica, princípios ativos e excipientes. Foram considerados os fatores impeditivos e de complicação relacionados à administração de medicamentos via sonda enteral e elaborou-se um quadro com informações sobre a possibilidade de administração por essa via e recomendações. **Resultados:** Foram analisados 234 medicamentos, sendo que os principais fatores de complicação encontrados com a administração via sonda enteral foram: alteração da farmacocinética da droga (38); danos ao trato gastrintestinal (9); obstrução da sonda (40); interação droga-nutriente (7); risco biológico (5); sem informação (33). **Conclusões:** A compilação dessas informações auxilia a equipe de saúde na escolha da forma farmacêutica adequada para administração via sonda enteral e pode contribuir para a identificação de eventos adversos relacionados à administração por esta via.

Descritores: Preparações farmacêuticas /administração & dosagem; Vias de administração de medicamentos

INTRODUCTION

Hospitalized patients unable to take medication *per oris* can optionally be given medication for oral delivery through an enteral feeding tube.

Various points need to be taken into account before starting therapy through an enteral tube, which may be an issue due to a lack of specific information in the literature as well as in the manufacturer's specifications[1]. Many recommendations are empirical, since drugs are usually not developed for enteral tube administration[1].

The technique for administering oral drugs in an enteral tube consists essentially of grinding the tables or opening the capsules and dissolving their content in water before giving these drugs through enteral tubes. However, many drugs cannot be ground or have their content removed from capsules, since such procedures may alter their pharmacokinetics, and thus complicate the enteral tube administering procedure. There may be

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additional issues such as drug-nutrient interactions, tube obstruction, gastrointestinal injury, and the biological risk due to carcinogenetic potential[2].

Therefore, giving drugs through the enteral tube route without a careful pharmacological and pharmacotechnical assessment may result in therapeutic failure, loss of the enteral tube, biological risk for healthcare professionals, and possible injury to patients.

OBJECTIVE

The purpose of this study was to analyze the oral drugs included on the formulary of Hospital Israelita Albert Einstein (HIAE) investigating the possibility of using these drugs through enteral feeding tubes, and recommending appropriate administration methods.

METHODS

This study consisted of identifying and analyzing the solid medication for oral delivery on the formulary of Hospital Israelita Albert Einstein; theses drugs are listed in the institution's Pharmaceutical Manual – 2008, 12th edition, which is published and reviewed annually.

A literature review was made by searching the PubMed/Medline, Lilacs and Cochrane Library databases, from 1980 to 2007, and by reviewing classical publications on the study theme. The most recent and representative papers and articles were selected for consensuses and guidelines.

Drug monographies and manufacturer information were sought by electronic mail when information was not available in the abovementioned review.

If these sources were insufficient, the pharmaceutical formulation, active ingredient and excipients of the drugs were analyzed according to their water solubility and efficacy when dissolved in water; the purpose was to classify the drug as adequate or not for administration through enteral tubes.

The complicating factors investigated were tube obstruction, drug-nutrient interaction, biological risk, possible gastrointestinal injury, altered pharmacokinetics, and the absence of studies or information that assured safe administration through the enteral tube route.

Tube obstruction was considered as drug precipitation or gel formation, after grinding that made it impossible to administer the drug and/or the diet through the enteral tube. Drug-nutrient interactions were any interactions between the administered drug and dietary components which affected the action of any or both of them. Biological risk was possible harm to healthcare workers as a consequence of inhaling airborne particles when grinding drugs with teratogenic and carcinogenic effects. Gastrointestinal injury was considered as the risk of harm caused by drugs after being ground and given through enteral tubes. The drug pharmacokinetic problems were inadequate drug absorption, toxicity risks, and decreased drug efficacy due to changes in its original pharmaceutical form.

Drugs were classified as inadequate for administration through enteral tubes when there was no safety information for this route.

Data were tabulated in an electronic spreadsheet and the information and explanations were presented in a chart (Chart 1).

RESULTS

The formulary for oral delivery that is used at the HIAE contains 234 drugs. The pharmaceutical formulations in this analysis were pills (13), capsules (34) and tablets (187).

Data on problems with drug administration through enteral tubes were subclassified as: altered drug pharmacokinetics (38); gastrointestinal tract injury (9); tube obstruction (40); drug-nutrient interactions (7); biological risk (5); and no information (33). This totalled 132 possible problems with drug administration through enteral feeding tubes.

As alternatives for administration through enteral feeding tubes it was suggested 57 liquid analogues to solid medications for oral delivery included on the formulary. Chart 1 shows the drugs that were analyzed, information about administration through enteral feeding tubes and specific recommendations.

DISCUSSION

Tablets were the most frequently used pharmaceutical formulation habitually given through tubes in this study. In this case, adequate tube washing before and after medication administering process assures the success of this procedure against tube obstruction[1].

The most frequent complication when giving medication through the enteral feeding tube is obstruction, which may interrupt drug therapy through this route[3-4]. Additionally, passing another tube is uncomfortable for patients and involves risks, such as accidental tube placement in the airways, and extra costs with materials and radiographs to confirm tube placement[5-7].

The following points should be taken into account to avoid enteral feeding tube obstruction due to inadequately prepared medication:

- some drugs, given their viscosity and pH, should not be given together with enteral formulae, since precipitates may form and obstruct the tube[5];

Chart 1. Medications for oral delivery administered through enteral tubes

Brand name	Active ingredient	Can the drug be given through an enteral tube?		Recommendations
		Yes	No	
Adalat® tablets	Nifedipine		x	Not recommended; the extracted dose may be incomplete, and the content may stick to the tube and cause obstruction[3].
Adalat Oros® tablets	Nifedipine		x	Should not be ground, since controlled release properties will be lost; this increases the risk of toxicity, inadequate serum levels of the drug, and tube obstruction[3].
Adalat Retard® tablets	Nifedipine		x	Should not be ground, since grinding causes this medication to lose controlled release features, increasing the risk of toxicity, inadequate serum levels, and tube obstruction[3].
Allegra® tablets	Fexofenadine		x	No available studies on efficacy, safety and pharmacokinetics
Akineton® tablets	Biperiden	x		
Aldactone® tablets	Spironolactone	x		
Aldomet® tablets	Methyldopa	x		
Amaryl® tablets	Glimepiride		x	Tablets are grooved and may be cut into two, but should not be macerated, according to the manufacturer's instructions.
Aminofilina® tablets	Aminophylline	x		
Amoxil® tablets	Amoxicillin		x	No available studies on efficacy, safety and pharmacokinetics. Alternative medication: Amoxil® Suspension.
Anafranil® pills	Clomipramine		x	Medication with coating and excipients that may obstruct tubes when macerated[3].
Antak® tablets	Ranitidine		x	Medication with coating and excipients that may obstruct tubes when macerated. Alternative medication: Label® Solution.
Apresolina® pills	Hydralazine	x		Monitor the blood pressure, as grinding may degrade the active ingredient and reduce drug efficacy[7].
Aropax® tablets	Paroxetine		x	Medication should not be macerated, and contains excipients that may obstruct tubes when macerated.
Asalit® tablets	Mesalazine		x	When ground, the drug becomes altered and loses efficacy.
Ascaridil® tablets	Levamisole	x		
Aspirina Infantil® tablets	Acetylsalicylic acid	x		
Aspirina Prevent® tablets	Acetylsalicylic acid		x	Loss of enteric coating due to grinding may inactivate the active ingredient and cause irritation of the gastric mucosa[3].
Atenol® tablets	Atenolol		x	Partially water-soluble active ingredient[7].
Atensina® tablets	Clonidine	x		
Atlansil® tablets	Amiodarone		x	No available studies on efficacy, safety and pharmacokinetics. Alternative medication: Ancoron® Drops[7].
Lipitor® tablets	Atorvastatin	x		
Azulfin® tablets	Sulfasalazine		x	Grinding causes loss of gastro-resistant coating which may inactivate the active ingredient and irritate the gastric mucosa[3].
Bactrim® tablets/Bactrim F® tablets	Trimethoprim + sulfamethoxazole		x	When macerated, active ingredient and excipients may cause tube obstruction[7]. Alternative medication: Bactrim® and Bactrim F Suspension®.
Beneroc® pills	B Complex		x	Medication with coating and excipients that may obstruct tubes when macerated[3]. Alternative medication: Beneroc® Drops
Benerva® tablets	Thiamine (vitamin B1)	x		Monitor possible gastrointestinal adverse reactions[8].
Benicar® tablets	Olmersatan		x	No available studies on efficacy, safety and pharmacokinetics.
Bufedil® tablets	Buflomedil		x	No available studies on efficacy, safety and pharmacokinetics.
Buscopan® pills	Scopolamine	x		Alternative medication: Buscopan Drops®.
Calcort® tablets	Deflazacort	x		
Capoten® tablets	Captopril	x		
Carbolitium® tablets	Lithium carbonate	x		
Cardizem® tablets	Diltiazem	x		
Carduran XL® tablets	Doxazosin		x	Should not be ground, as controlled release features are lost, increasing the risk of toxicity and inadequate serum levels[3].
Cebralat® tablets	Cilostazol	x		
Cefamox® tablets	Cephadroxyl		x	No available studies on efficacy, safety and pharmacokinetics. Alternative medication: Cefamox Suspension®.
Cellcept® tablets	Mophetil		x	Medication should not be macerated, due to risk of carcinogenesis. Contact the pharmacy, since grinding should be done under laminar airflow[9]. Alternative medication: Cellcept Suspension®.

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Brand name	Active ingredient	Can the drug be given through an enteral tube?		Recommendations
		Yes	No	
Cewin® tablets	Ascorbic acid		x	Prolonged release tables contain hydroxypropylmethylcellulose (becomes viscous in water) and ascorbic acid (may degrade due to humidity), increasing the risk of tube obstruction. Alternative medication: Redoxon Drops®.
Cipramil® tablets	Citalopram	x		
Cipro® tablets	Ciprofloxacin	x		Administering ciprofloxacin and enteral diets may cause decreased absorption of the drug. The enteral diet should be stopped 1 hour before and restarted 1 hour after drug administration[8].
Citoneurin® pills	Cyanocobalamin + pyridoxine + thiamine		x	Medication with coating and excipients that may obstruct tubes when macerated.
Claritin® tablets	Loratadine	x		Alternative medication: Claritin Syrup®.
Clavulin® tablets	Clavulanic acid + amoxicillin	x		Alternative medication: Clavulin Suspension®.
Clorana® tablets	Hydrochlorothiazide	x		
Comtan® tablets	Entacapone	x		
Coreg® tablets	Carvedilol	x		
Corgard® tablets	Nadolol		x	No available studies on efficacy, safety and pharmacokinetics.
Coumadin® tablets	Warfarin	x		The enteral diet may decrease the concentration of warfarin; serum levels should be monitored[8].
Cozaar® tablets	Losartan	x		
Creon® tablets	Pancrelipase		x	Medication contains granules that should not be macerated, as efficacy may be lost[9].
Cronomet® tablets	Carbidopa + levodopa		x	Should not be ground, as controlled release features are lost, increasing the risk of toxicity and inadequate serum levels, and tube obstruction.
Cymbalta® tablets	Duloxetine		x	Granules may obstruct tubes when macerated.
Dactil-ob® pills	Piperidolate + hisperidin + ascorbic acid		x	Medication with coating and excipients that may obstruct tubes when macerated.
Dalacin® tablets	Clindamycin	x		Capsules may be opened and the content may be diluted in water. May cause gastrointestinal irritation and injury[9].
Dalmadorm® tablets	Flurazepam	x		
Daonil® tablets	Glibenclamide	x		
DDAVP® tablets	Desmopressin		x	Desmopressin is composed of an amino acid chain; in an acid media, some bonds are broken. If tablets are macerated, the area of contact is increased and more bonds are broken.
Decadron® tablets	Dexametasone	x		Alternative medication: Decadron Elixir®.
Depakene® tablets	Valproic acid	x		May irritate the gastrointestinal tract[8].
Depakote® tablets	Sodium divalproate		x	Loss of enteric coating due to grinding may inactivate the active ingredient and/or cause irritation of the gastric mucosa. Alternative medication: Valpakine Solution® and Depakene syrup®.
Detrusitol® tablets	Tolterodine		x	No available studies on efficacy, safety and pharmacokinetics[9].
Diamicron MR® tablets	Gliclazide		x	Should not be ground, as controlled release features are lost, increasing the risk of toxicity and inadequate serum levels[3].
Diamox® tablets	Acetazolamide	x		
Digesan® tablets	Bromopride		x	No available studies on efficacy, safety and pharmacokinetics Alternative medication: Digesan Drops®.
Digoxina® tablets	Digoxin	x		Alternative medication: Digoxina® Elixir.
Dilacoron® tablets	Verapamil	x		
Dimorf® tablets	Morphine	x		
Diovan® tablets	Valsartan	x		
Donaren® tablets	Trazodone	x		
Dormonid® tablets	Midazolam	x		Alternative medication: Dormire Solution®.
Dostinex® tablets	Cabergoline		x	No available studies on efficacy, safety and pharmacokinetics
Dramin B6® tablets	Dimenhydrinate + pyridoxine	x		Alternative medication: Dramin Drops®.
Dulcolax® pills	Bisacodyl		x	Loss of enteric coating due to grinding may inactivate the active ingredient[9]. Alternative medication: Dulcolax Drops®.
Duspatalin® tablets	Mebeverine		x	No available studies on efficacy, safety and pharmacokinetics.
Ebix® tablets	Memantine		x	No available studies on efficacy, safety and pharmacokinetics.
Efexor XR® tablets	Venlafaxine		x	Should not be ground, as controlled release features are lost, increasing the risk of toxicity and inadequate serum levels, and tube obstruction[3].
Emend® tablets	Aprepitant		x	Excipients may cause tube obstruction. Capsules should not be opened.

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Brand name	Active ingredient	Can the drug be given through an enteral tube?		Recommendations
		Yes	No	
Endofolin® tablets	Folic acid	x		Alternative medication: Endofolin Drops® or Endofolin Solution®.
Entocort® tablets	Budesonide		x	Loss of enteric coating by grinding causes inactivation of the active ingredient; the drug is not absorbed (controlled ileal release) and tube obstruction ensues[3].
Ephynal® tablets	Tocopherol		x	Not recommended; the extracted dose may be insufficient and the content may adhere to the tube, causing obstruction.
Epivir® tablets	Lamivudine		x	No available studies on efficacy, safety and pharmacokinetics. Alternative medication: Epivir® Solution[9].
Eranz® tablets	Donepezil	x		
Exelon® tablets	Rivastigmine		x	No available studies on efficacy, safety and pharmacokinetics. Alternative medication: Exelon Solution®.
Ezetrol® tablets	Ezetimibe	x		
Fenergan® tablets	Promethazine	x		
Flagyl® tablets	Metronidazole	x		Alternative medication: Flagyl Solution®.
Floratil® tablets	*Saccharomyces boulardii*	x		Capsules may be opened and contents be dissolved in water.
Florinefe® tablets	Fludrocortisone	x		
Flunarin® tablets	Flunarizine		x	Medication contains excipients that when macerated and solubilized may obstruct the tube.
Fosamax® tablets	Sodium alendronate		x	Should not be ground, as controlled release features are lost, increasing the risk of toxicity and inadequate serum levels, and tube obstruction[3].
Frisium® tablets	Clobazam	x		
Frontal® tablets	Alprazolam	x		
Gardenal® tablets	Fenobarbital	x		Alternative medication: Gardenal Drops®.
Glucoformin® tablets	Metformin	x		Risk of obstruction in small diameter tubes[9].
Haldol® tablets	Haloperidol	x		Alternative medication: Haldol Drops®.
Hidantal® tablets	Phenytoin	x		Monitor serum levels, since the absorption of fenitoin when mixed with enteral diets may be compromised. The enteral diet should be stopped 1 hour before and restarted 2 hours after drug administration[9]. Alternative medication: Epelin® Solution.
Hixizine® tablets	Hydroxyzine	x		Alternative medication: Hixizine® Syrup.
Higroton® tablets	Chlorthalidone	x		
Iberin Fólico® tablets	Folic acid + ferrous sulphate + ascorbic acid		x	Medication with coating and excipients that may obstruct tubes when macerated.
Imigran® tablets	Sumatriptan		x	No available studies on efficacy, safety and pharmacokinetics.
Imosec® tablets	Loperamide	x		
Imovane® tablets	Zopiclone		x	No available studies on efficacy, safety and pharmacokinetics.
Imuran® tablets	Azathioprine		x	Medication should not be macerated due to risk of carcinogenesis. Contact the pharmacy, since grinding should be done under laminar airflow[9].
Inderal® tablets	Propranolol	x		
Indocid® tablets	Indomethacin		x	Water-insoluble active ingredient; may obstruct the tube[7].
Ipsilon® tablets	Aminocaproic acid	x		
Isocord® tablets	Isosorbide dinitrate	x		
Isordil SL® tablets	Isosorbide dinitrate		x	Should not be ground, as release features are lost, resulting in inadequate drug serum levels[3].
Keflex® pills	Cephalexin		x	Medication with coating and excipients that may obstruct tubes when macerated[3]. Alternative medication: Keflex Suspension®.
Klaricid® tablets	Clarithromycin		x	No available studies on efficacy, safety and pharmacokinetics. Alternative medication: Klaricid Suspension®.
Lamictal® tablets	Lamotrigine	x		
Lasix® tablets	Furosemide	x		Alternative medication: Extemporaneous Solution Furosemide 1 mg/ml.
Levaquin® tablets	Levofloxacin	x		Levofloxacin mixed with enteral diets may be less absorbed. The enteral diet should be stopped 1 hour before and restarted 1 hour after drug administration[8].
Lexapro® tablets	Escitalopram	x		Alternative medication: Lexapro® Drops.
Lexotan® tablets	Bromazepam	x		Alternative medication: Lexotan® Drops.
Lioresal® tablets	Baclofen	x		
Lisador® tablets	Adiphenine + promethazine + dipyrone	x		Alternative medication: Lisador Drops®.

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Brand name	Active ingredient	Can the drug be given through an enteral tube?		Recommendations
		Yes	No	
Lopid® tablets	Gemfibrozil		x	Medication with coating and excipients that may obstruct tubes when macerated.
Lorax® tablets	Lorazepam	x		
Losec Mups® tablets	Omeprazole	x		Do not macerate. Tables should be dispersed in water and the resulting solution should be given within 30 minutes.
Ludiomil® tablets	Maprotiline	x		
Luftal® tablets	Dimethicone	x		Alternative medication: Luftal Drops®.
Macrodantina® tablets	Nitrofurantoin		x	No available studies on efficacy, safety and pharmacokinetics. Alternative medication: Hantina Suspension®[9].
Maxalt RPD® tablets	Rizatriptan		x	Should not be ground, as release features are lost, resulting in inadequate drug serum levels[3].
Megestat® tablets	Megestrol	x		Alternative medication: Megestat® Suspension.
Mestinon® tablets	Pyridostigmine	x		
Metadon® tablets	Methadone	x		
Meticorten® tablets	Prednisone	x		
Miosan® tablets	Cyclobenzaprine	x		
Moduretic® tablets	Amiloride + hydrochlorothiazide	x		
Monocordil® tablets	Isosorbide (mononitrate)	x		
Motilium® tablets	Domperidone	x		Alternative medication: Motilium Solution®.
Myfortic® tablets	Mycophenolate		x	Medication coating makes grinding difficult; may obstruct the tube when macerated. Risk of carcinogenesis when macerated[3].
Mytedon® tablets	Methadone	x		Should be given immediately after grinding. It may cause obstruction in small diameter tubes[9].
Naprosyn® tablets	Naproxen	x		
Neosaldina® pills	Isometheptene + caffeine + dipyrone		x	Medication with coating and excipients that may obstruct tubes when macerated[3]. Alternative medication: Neosaldina Drops®.
Neurontin® tablets	Gabapentin	x		Capsules may be opened and the content may be dissolved in water immediately before administration[9].
Neutrofer® tablets	Iron glycinate chelate	x		Table dissolution in water may take a few minutes[7].
Nexium® tablets	Esomeprazole	x		Do not grind. The tablet should be dispersed in water and the resulting solution should be given through the tube.
Niar® tablets	Selegiline	x		
Nizoral® tablets	Ketoconazole	x		
Nimotop® tablets	Nimodipine		x	No available studies on efficacy, safety and pharmacokinetics[9].
Noripurum® tablets	Iron (III)-hydroxide		x	No available studies on efficacy, safety and pharmacokinetics. Alternative medication: Noripurum® Drops and Noripurum® Syrup[9].
Norvasc® tablets	Amlodipine	x		
Novalgina® tablets	Dipyrone	x		Alternative medication: Novalgina® Drops.
Os-cal D® tablets	Calcium carbonate		x	High risk of enteral feeding tube obstruction[7].
Oxycontin® tablets	Oxycodone		x	Should not be ground, as controlled release features are lost, increasing the risk of toxicity and inadequate serum levels[3].
Pamelor® tablets	Nortriptyline	x		Capsules may be opened and the content may be dissolved in water immediately before administration.
Pantozol® tablets	Pantoprazole		x	Loss of enteric coating due to grinding may inactivate the active ingredient and/or cause irritation of the gastric mucosa.
Parlodel® tablets	Bromocriptine	x		
Pentox® tablets	Pentoxifylline		x	Tablet contains a core that hinders prompt release of the drug, altering its efficacy.
Persantin® tablets	Dipyridamole	x		
Plasil® tablets	Metoclopramide	x		Alternative medication: Plasil Drops®.
Plavix® tablets	Clopidogrel	x		
Polaramine® tablets	Dexchlorpheniramine maleate		x	No available studies on efficacy, safety and pharmacokinetics. Alternative medication: Polaramine Solution®.
Prevax® tablets	Calcium folinate	x		
Prinivil® tablets	Lisinopril	x		
Profenid® tablets	Ketoprofen	x		The capsule may be opened and its content may be dissolved in water immediately before administration. Alternative medication: Profenid® Drops

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Brand name	Active ingredient	Can the drug be given through an enteral tube?		Recommendations
		Yes	No	
Prograf® tablets	Tacrolimus	x		
Prolopa® tablets	Benserazide + levodopa	x		Prolopa® mixed with enteral diets may not be absorbed adequately. The enteral diet should be stopped 1 hour before and restarted 1 hour after drug administration.
Proscar® tablets	Finasteride	x		Finasteride tablets should not be ground if pregnant women are present to avoid exposure to this drug.
Prozac® tablets	Fluoxetine	x		The capsule may be opened and its content may be dissolved in water immediately before administration. Alternative medication: Daforin® Drops.
Pyridium® pills	Phenazopyridine	x		Should be diluted in 20 ml or more[9].
Quemicetina® pills	Chloramphenicol		x	Medication with coating and excipients that may obstruct tubes when macerated[3]. Alternative medication: Quemicetina® Syrup.
Quinicardine® tablets	Quinicardine		x	No available studies on efficacy, safety and pharmacokinetics.
Remeron Soltab® tablets			x	Should not be ground, as release features are lost, resulting in inadequate drug serum levels[3].
Reminyl ER® tablets	Galantamine		x	Should not be ground, as controlled release features are lost, increasing the risk of toxicity and inadequate serum levels, and tube obstruction[3].
Renitec® tablets	Enalapril	x		
Retemic® tablets	Oxybutynin	x		Alternative medication: Retemic Syrup®.
Revatio® tablets	Sildenafil	x		
Revectina® tablets	Ivermectin		x	No available studies on efficacy, safety and pharmacokinetics.
Rifaldin® tablets	Rifampicin		x	No available studies on efficacy, safety and pharmacokinetics. Alternative medication: Rifaldin® Suspension.
Risperdal® tablets	Risperidone	x		Alternative medication: Risperdal Solution®.
Ritalina® tablets	Methylphenidate		x	No available studies on efficacy, safety and pharmacokinetics.
Ritmonorm® tablets	Propafenone	x		
Rivotril® tablets	Clonazepam	x		Alternative medication: Rivotril Drops®.
Rocaltrol® tablets	Calcitriol		x	Not recommended; the extracted dose may be incomplete and the content may adhere to the tube, causing obstruction.
Rohypnol® tablets	Flunitrazepam	x		
Sabril® tablets	Vigabatrin	x		
Sandimmun Neoral® tablets	Cyclosporine		x	Carcinogenic risk when macerated[9]. Alternative medication: Sandimmun Solution®.
Secotex® tablets	Tamsulosin		x	Grinding and solubilizing of active ingredient not recommended[9]. Alternative medication: Extemporaneous solution.
Seis-B® tablets	Pyridoxine	x		There may be adverse effects on the gastrointestinal tract[8].
Seloken® tablets	Metoprolol	x		
Seroquel® tablets	Quetiapine	x		
Sifrol® tablets	Pramipexole	x		
Sinemet® tablets	Carbidopa + levodopa	x		Sinemet® mixed with enteral diets may be less absorbed. The enteral diet should be stopped 1 hour before and restarted 1 hour after drug administration[8].
Singulair® tablets	Montelukast	x		
Sirdalud® tablets	Tizanidine	x		
Slow-K® pills	Potassium chloride	x		Should not be macerated; slow release feature is lost, and macerated tablet coating may obstruct the tube[3]. Alternative medication: Potassium chloride 6%® Syrup.
Sotacor® cp	Sotalol	x		
Sporanox® tablets	Itraconazole		x	High obstruction rate[7]. Alternative medication: Extemporaneous solution.
Stilnox® tablets	Zolpidem	x		
Synthroid® tablets	Levothyroxine sodium	x		Monitor serum level, since Synthroid® mixed with enteral diets may be less absorbed. The enteral diet should be stopped 1 hour before and restarted 1 hour after drug administration[8].
Supradyn® pills	Multivitamins		x	Medication with coating and excipients that may obstruct tubes when macerated[3].
Survector® tablets	Amineptine		x	No available studies on efficacy, safety and pharmacokinetics.
Sustrate SL® tablets	Propatylnitrate		x	Should not be ground, as release features are lost, resulting in inadequate drug serum levels[3].
Talofilina® tablets	Theophylline		x	Should not be ground, as controlled release features are lost, resulting in toxicity, inadequate drug serum levels, and tube obstruction[3].
Tamiflu® tablets	Oseltamivir	x		
Tapazol® tablets	Methimazole		x	No available studies on efficacy, safety and pharmacokinetics.

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Brand name	Active ingredient	Can the drug be given through an enteral tube?		Recommendations
		Yes	No	
Tegretol® tablets	Carbamazepine	x		Alternative medication: Tegretol Syrup®. Studies have shown that carbamazepine syrup is absorbed through enteral tubes. Should be diluted in an equal amount of water before administration to avoid loss of efficacy[9].
Thiaben® tablets	Thiabendazol		x	No available studies on efficacy, safety and pharmacokinetics.
Ticlid® tablets	Ticlopidine	x		
Tilatil® tablets	Tenoxicam		x	The active ingredient may obstruct the tube when solubilized in water[7].
Tiorfan® tablets	Racecadotril	x		Capsules may be opened and the content may be dissolved in water immediately before administration.
Tofranil® pills	Imipramine	x		
Topamax® tablets	Topiramate	x		
Toragesic SL® tablets	Ketorolac		x	Should not be ground, as release features are lost, resulting in inadequate drug serum levels[3].
Tramal® tablets	Tramadol	x		Alternative medication: Tramal Drops®.
Transamin® tablets	Tranexamic Acid	x		
Triatec® tablets	Ramipril		x	No available studies on efficacy, safety and pharmacokinetics.
Trileptal® tablets	Oxacarbazepine	x		Alternative medication: Trileptal Solution®.
Tryptanol® tablets	Amitriptyline	x		
Tylenol® tablets	Paracetamol	x		Alternative medication: Tylenol Drops®.
Tylex® tablets	Codeine + paracetamol	x		
Ursacol® tablets	Ursodeoxycholic acid	x		
Valium® tablets	Diazepam	x		
Valtrex® tablets	Valaciclovir	x		
Vasoton® tablets	Verapamil	x		
Vastarel® tablets	Trimetazidine		x	No available studies on efficacy, safety and pharmacokinetics.
Vfend® tablets	Voriconazole	x		
Virazole® tablets	Ribavirin	x		
Voltaren® tablets	Diclofenac sodium		x	Loss of enteric coating due to grinding may inactivate the active ingredient and/or cause irritation of the gastric mucosa[3].
Zentel® tablets	Albendazol	x		
Zestril® tablets	Lisinopril	x		
Zinnat® tablets	Cefuroxime		x	Should not be macerated, according to the manufacturer's instructions. Alternative medication: Zinnat® Suspension.
Zitromax® tablets	Azithromycin	x		Alternative medication: Zitromax® Suspension®.
Zocor® tablets	Simvastatin	x		Dissolving these tables in water may take a few minutes[9].
Zofran® tablets	Ondansentron	x		
Zoloft® tablets	Sertraline	x		The risk of tube obstruction is increased[7].
Zoltec® tablets	Fluconazole	x		Open capsule and wait dissolution of granules; do not grind. Administer after full solubilization[9].
Zovirax® tablets	Aciclovir	x		
Zyban® tablets	Bupropion		x	Should not be ground, as controlled release features are lost, increasing the risk of toxicity and inadequate serum levels, and tube obstruction[3].
Zyloric® tablets	Allopurinol	x		
Zyprexa ® tablets	Olanzapine	x		
Zyvox® tablets	Linezolide		x	Medication with coating and excipients that may obstruct tubes when macerated.

- when ground and solubilized, slow release and enteric release tablets may form a gel that may obstruct the tube[8].

A frequent problem is that drug pharmacokinetics may be altered. Absorption is the transference of a drug from its administration site to its action site. A drug delivered orally is first absorbed by the stomach and intestines; this process, however, may be compromised by drug-preparation procedures and its physical and chemical properties. Bioavailability depends on the anatomical structure in which absorption takes place. Other anatomical, physiological and pathological factors may also affect bioavailability and choosing an

administration route for a drug should be based on knowledge of these factors[9-10].

Thus, the portion of the gastrointestinal tract, in which the drug is absorbed (stomach or intestines), should be known to check whether the position of the enteral tube would affect absorption or not[8].

Medications that require fasting to be given require careful planning of drug delivery and diet. Slow release drugs have this property disturbed when ground resulting in erratic blood levels of these drugs[5]; absorption may be increased or decreased in these cases.

Further complication factors are the risks for healthcare professionals that handle and administer the medications through the enteral tube. Particles released by grinding of medication may be inhaled; these drugs may be teratogenic, carcinogenic or cytotoxic, such as antineoplastic drugs, hormones and prostaglandin analogues[8].

Drug administration through the enteral tube should be assessed carefully due to the abovementioned complications. Chart 1 provides supporting information for this assessment.

CONCLUSIONS

The information compiled may help healthcare teams to choose the appropriate pharmaceutical form of a drug to be given through an enteral feeding tube; it may also provide support to identify adverse effects resulting from drug administration through this route.

Safety and therapeutic efficacy, when administering solid drugs for oral delivery through enteral feeding tubes, may be enhanced by implementing procedures based on the information provided in Chart 1.

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