

Original Research

Physical incompatibility of sodium bicarbonate, amiodarone, dextromethorphan, and memantine tablets coadministered via a nasogastric tube: A case report

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Abstract

Introduction: Coadministration of multiple oral medications through a nasogastric (NG) tube can lead to unexpected physical incompatibilities that compromise drug delivery and patient safety. This case report describes recurrent NG tube obstruction following the simultaneous administration of sodium bicarbonate, amiodarone, dextromethorphan, and memantine tablets, highlighting a preventable yet clinically significant interaction. **Discussion:** The combination produced a viscous, resin-like precipitate that repeatedly clogged the NG tube and necessitated tube replacement. A bedside, semi-qualitative simulation experiment reproduced the same phenomenon, with precipitate formation occurring shortly after mixing, suggesting a pH-dependent conversion of amiodarone hydrochloride to its poorly soluble free-base form in the presence of sodium bicarbonate. This finding emphasizes the potential for physical incompatibilities between alkaline agents and weakly basic drugs during enteral medication preparation and administration. Simple pre-administration compatibility testing may help clinicians and caregivers identify such risks and prevent complications. **Conclusion:** This case underscores the importance of evaluating the physical compatibility of crushed or dispersed medications prior to enteral administration, particularly in patients with polypharmacy. Increased awareness and individualized preparation strategies can reduce the risk of tube obstruction and ensure safe and effective drug delivery via NG tubes.

Keywords: physical incompatibility, sodium bicarbonate, amiodarone, dextromethorphan, memantine, nasogastric tube feeding

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INTRODUCTION

Enteral administration of oral medications through nasogastric (NG) tubes is a common but often challenging practice, in patients requiring multiple oral solid dosage forms. Since most available medications are formulated as tablets or capsules, crushing or opening capsules is frequently required before administration through feeding tubes¹. Each medication should ideally be dissolved or suspended in an appropriate vehicle and administered via the feeding tube immediately or shortly to maintain its stability. Best practice involves administering each medication separately and flushing the tube with at least 15 mL of water between doses to reduce the potential for physical or chemical incompatibility of active ingredients and/or excipients¹. However, clinical practice frequently deviates from these recommendations due to time constraints, limited caregiver training, and the need to restrict water intake in certain

patients, such as those with heart failure, chronic kidney disease, or ascites^{2,3}. These limitations may lead to simultaneous preparation of multiple crushed medications, increasing the risk of physical or chemical incompatibility. Tube obstruction, reported in up to 25–35% of cases, can result from medication precipitation, pH-related changes in solubility, or interactions between excipients and the vehicle¹. For patients receiving polypharmacy regimens via NG tubes, such incompatibilities can cause significant harm by reducing medication delivery, delaying therapy, and requiring repeated tube replacements. Unfortunately, clinicians and caregivers often lack accessible methods to verify compatibility before drug administration. This report presents a case of physical incompatibility encountered when sodium bicarbonate, amiodarone, dextromethorphan, and memantine tablets were mixed and administered together via NG tube. Importantly, it also demonstrates that simple, reproducible bedside experiments can be used to preliminarily examine suspected incompatibilities in real clinical settings, empowering healthcare professionals to identify and prevent tube obstruction events before they occur.

CASE REPORT

A case of an 81-year-old female patient, bedridden and dependent on NG tube feeding, was consulted by the homecare team due to excessive recurrent obstruction of the feeding tube, suspected of a medication-related problem. Her medical history included subdural hemorrhage, metastatic non-small cell lung cancer with bone and brain involvement, chronic deep vein thrombosis at the right leg, and Alzheimer's disease. She was prescribed multiple medications administered through her NG tube, as outlined in Table 1. Due to the complexity and volume



Table 1. List of patient's medications

Medication (trade name- strength)	Regimen
Amiodarone (Zydarone® 200 mg)	1 tab BID pc
Dextromethorphan (Icolid® 15 mg)	1 tab BID pc
Folic acid (Folivit® 5 mg)	1 tab OD pc AM
Furosemide (Furetic® 40 mg)	0.5 tabs OD pc AM
Lansoprazole (Prevacid® 30 mg)	1 tab OD ac AM
Levodopa/benserazide (Madopar® 200/50 mg)	0.25 tabs QID ac
Memantine (Neumantine® 10 mg)	1 tab BID pc
Sodium bicarbonate (Sodamint Frx® 300 mg)	1 tab BID pc
Vitamin B1, B6, B12 (Sambee® 100/5/0.065 mg)	1 tab OD pc AM



Figure 1. A dark brown to black, sticky precipitate in the mortar (left) and the outlet of the tube (right)

of her regimen, several medications, including amiodarone, dextromethorphan, levodopa/benserazide, memantine, sodium bicarbonate, and vitamin B supplements, were crushed and mixed with water for simultaneous administration. A dark brown to black, sticky precipitate was observed in the mortar used to prepare these medications and at the outlet of the tube as shown in Figure 1. As a corrective measure, the clinical pharmacist, based on the caregiver's initial observation, recommended preparing levodopa/benserazide and vitamin B supplements separately due to their distinctive orange and pink colors, respectively, while the remaining medications continued to be mixed together. Although this adjustment resulted in a color change to an off-white or grayish precipitate, the mixture remained highly viscous and sticky.

The patient's caregiver attempted to isolate the cause of the reaction by mixing sodium bicarbonate with each medication

individually and noted that only amiodarone produced a similar reaction, suggesting an interaction specific to these two medications.

Upon consultation, the pharmacist hypothesized that a pH-induced change in the solubility of amiodarone might be responsible for the formation of the precipitate. To explore this hypothesis, a series of simple experiments was conducted in the pharmacy department. Each of the patient's medications, except sodium bicarbonate, was crushed and dispersed with 15 mL of water, followed by the addition of a crushed 300 mg tablet of sodium bicarbonate. Mixing was performed manually either by gentle stirring with a spoon in a cup or by grinding with a pestle in a mortar, at room temperature (approximately 25°C), mimicking real-world bedside preparation conditions rather than controlled laboratory agitation. Each experiment was repeated at least twice on separate occasions, yielding consistent visual and physical characteristics of the precipitate.

The results are summarized in Table 2 and illustrated in Figure 2 and Figure 3. A coarse, off-white precipitate, partially dispersible on stirring formed rapidly, within approximately 1-3 minutes, specifically in mixtures containing amiodarone and sodium bicarbonate, confirming the suspected interaction.

Upon confirmation of the incompatibility, the pharmacist discussed the findings with the caregiver, validating that the initial interim separation strategy was appropriate. Although the patient later succumbed to her underlying disease, this investigation enabled the pharmacist to establish a specific administration protocol requiring separation of these agents, with the aim of preventing similar nasogastric tube obstructions in future practice.

DISCUSSION

This case report describes a previously unreported physical incompatibility between amiodarone and sodium bicarbonate when coadministered with other common medications via NG tube. The observed reaction produced a sticky, resin-like precipitate, leading to frequent tube obstruction. To our knowledge, existing evidence regarding amiodarone and sodium bicarbonate incompatibility is limited to intravenous Y-site administration⁴. This report is the first to document this incompatibility in the enteral setting, highlighting a distinct and under-recognized clinical risk. The observation is clinically significant as such physical incompatibilities can lead to frequent clogging of NG tubes, requiring repeated tube changes, which are not only uncomfortable for the patient but also increase the risk of treatment failure, infections, and add to healthcare costs.

Based on follow-up tests, the most plausible mechanism involves the conversion of amiodarone hydrochloride into its free-base form due to alkalization by sodium bicarbonate. Given the practically water insoluble of amiodarone in its basic form, it is formulated as a hydrochloride salt to enhance

Table 2. Results of mixing other oral medications with a crushed tablet of 300 mg sodium bicarbonate				
Experiment number	Mixed medications	Immediate appearance	Final observation	Interpretation
		(within 5 minutes)	(30 minutes after mixing)	
Exp #1	A + S	Coarse off-white precipitate, partially dispersible on stirring	Coarse precipitate	Incompatible
Exp #2	D + S	Fine slightly yellow suspension, well-dispersed on stirring	Fine precipitate	Compatible
Exp #3	M + S	Fine white suspension, well-dispersed on stirring	Fine precipitate	Compatible
Exp #4	A + M + S	Coarse off-white precipitate, partially dispersible on stirring	Sticky mass	Incompatible
Exp #5	A + D + S	Coarse off-white to grayish precipitate, partially dispersible on stirring	Sticky mass	Incompatible
Exp #6	D + M + S	Fine slightly yellow suspension, well-dispersed on stirring	Fine precipitate	Compatible
Exp #7	A + D + M + S	Coarse off-white to grayish precipitate, partially dispersible on stirring	Sticky mass	Incompatible

*A=amiodarone (Zydarone® 200 mg), D=dextromethorphan (Icolid® 15 mg), M=memantine (Neumantine® 10 mg), S=sodium bicarbonate (Sodamint Frx® 300 mg)



Figure 2. Immediate results of mixing of dispersion of other medications with sodium bicarbonate; amiodarone + memantine (Exp #4, left), amiodarone + dextromethorphan (Exp #5, middle), dextromethorphan + memantine (Exp #6, right)



Figure 3. Results of mixing of amiodarone, dextromethorphan, memantine, and sodium bicarbonate (Exp #7); the immediate result of amiodarone + dextromethorphan + memantine (upper left), the immediate result of amiodarone + dextromethorphan + memantine mixed with sodium bicarbonate (upper right), the sticky paste of amiodarone + dextromethorphan + memantine mixed with sodium bicarbonate (lower left and right)

solubility from approximately 2 pg/mL to 0.2-0.7 mg/mL at room temperature⁵⁻⁷. Although dextromethorphan and memantine were also suspected as potential contributors to the reaction, they did not exhibit similar reactions, likely due to their lower doses in comparison to amiodarone. Interestingly, the sticky precipitate generated from mixing amiodarone, dextromethorphan, memantine, and sodium bicarbonate (Exp #7) was resistant to dissolution in water and common detergents but was successfully removed using vegetable oil. This phenomenon suggests that certain excipients within the tablet, possibly binding agents or lubricants, may have interacted under altered pH conditions to form a resinous material, that merits further study.

Other causes of tube clogging include precipitation of protein by gastric acid which is the anticipated cause for 80% of the cases. Excessive food retention due to inappropriate feeding rates, bacterial contamination and colonization in the tube, and sizes and number of outlets of the tube have also been observed as contributing factors for tube clogging^{8,9}. The feeding tubes with smaller sizes or more outlets have higher chances of clogging. In addition, medication administration via the feeding tube could play a role in promoting tube clogging by several means. Dispersed insoluble solid medications that have coarse sizes of particles since inadequate size reduction procedure could clog the tube easily whereas some active ingredients or excipients may be swollen or become stickier when they are exposed to a vehicle. Precipitates from complexation reactions of food contents, supplements, and medications such as calcium or ferrous ions and ciprofloxacin have been observed clogging the tube^{10,11}.

Solubility of oral medications is essential for their absorption. For the drugs that are poorly soluble, their salt forms with higher solubility and suitable for gastrointestinal absorption have been used. Changes in pH during preparation for tube feeding caused by the added vehicle, mixing, or coadministration with other medications could affect the solubility of the medication, and lead to precipitation and obstruction of the feeding tube. Medications with significant effects on the pH of their surroundings, e.g., sodium bicarbonate, calcium carbonate, aspirin, and ascorbic acid have been widely used in clinical practice. Improper administration of these medications via tube feeding could reduce the efficacy of the treatment regimen and put patients in harmful situations^{12,13}.

The frequent obstruction of NG tubes, as seen in this case, poses several clinical challenges, including reduced medication efficacy, diminished patient quality of life, increased caregiver workload, and higher healthcare costs. Therefore, careful attention should be given to the coadministration of medications with significant pH-altering effects, particularly

those with limited solubility profiles, in patients requiring NG tube feeding. This report emphasizes the importance of awareness and adherence to NG administration guidelines to mitigate adverse outcomes associated with medication incompatibility.

This investigation should be interpreted as a semi-qualitative physical compatibility assessment conducted under bedside-simulated conditions, rather than a formal stability or physicochemical compatibility study. The objective was to reproduce and visually characterize the clinically observed incompatibility in a manner that reflects real-world enteral medication preparation. This report underscores the practical value of simple bedside compatibility testing in resolving uncertainties when formal data or laboratory resources are unavailable. As demonstrated in this case, a small-scale, reproducible test, such as mixing crushed tablets in water and observing changes in appearance or consistency, can identify potential incompatibility prior to administration. The procedure requires minimal materials, can be safely performed at the bedside or in a pharmacy preparation area, and can guide immediate corrective actions, including separating administration times or ensuring adequate flushing between medications. Although limited to visual and physical assessment, this pragmatic approach provides an accessible risk-mitigation strategy to help prevent tube obstruction, medication loss, and patient discomfort.

The pharmacist played a central role throughout the identification and management of this incompatibility. First, the pharmacist identified medication-related causes of recurrent NG tube obstruction through systematic review of the administration process and caregiver interviews. Second, the pharmacist designed and conducted simple bedside-simulated mixing experiments to isolate the offending combination and confirm reproducibility of the reaction. Finally, corrective actions were implemented, including separation of administration times and avoidance of co-mixing sodium bicarbonate with amiodarone, resulting in prevention of further tube obstruction.

CONCLUSION

The concurrent administration of sodium bicarbonate with medications that possess limited solubility, such as amiodarone, should be avoided in NG tube feeding due to the risk of physical incompatibility. This case report serves as a reminder to healthcare providers of the potential for significant adverse events resulting from incompatible medication combinations and highlights the need for careful planning and adherence to best practices in the preparation and administration of medications for NG tube delivery.



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