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Supporting Documentation
On Gastric Lavage

Modifications in the Technique of Gastric Lavage

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ORIGINAL CONTRIBUTION

Modifications in the Technique of Gastric Lavage

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A simple experimental model was used to demonstrate the effects of water temperature and mechanical agitation in removing pills during gastric lavage. It was nearly impossible to remove pills from an artificial stomach using room temperature water and no mechanical agitation. Using warm tap water and repetitive compressions of the artificial stomach, the pills were consistently removed with ease. We recommend that gastric lavage for poisoning victims include two phases, the first using traditional lavage technique, and the second using larger aliquots, warm lavage fluid, and massage of the epigastrium. McDougal CB, Maclean MA: Modifications in the technique of gastric lavage. *Ann Emerg Med* 10:514-517, October 1981.
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INTRODUCTION

Gastric lavage for poisoning victims is used when the patient's state of consciousness makes ipecac-induced emesis inadvisable. Typically 200-cc to 300-cc aliquots of saline or tap water are administered via a large-bore tube directly into the stomach, and after each aliquot, the fluid is either removed by suction or the tube is lowered to the floor and the lavage fluid is siphoned out.[1-5] A total of 20 L to 100 L is instilled routinely in many European centers,[1] but the more common practice in this country is to discontinue the procedure when the lavage fluid consistently returns clear.

Warming of the lavage fluid has been recommended in the past, especially in infants.[1] The rationale, however, has been to avoid hypothermia rather than to increase solubility. Massage of the epigastrium to break up concretions has been described by Bartecchi.[6,7] However, the technique has not become widely known. We believe that the following simple study is strongly suggestive of the value of using warmed lavage fluid and epigastric massage.

MATERIALS AND METHODS

A 1,000-cc plastic intravenous (IV) infusion bag was used to represent the stomach, and a #32 French lavage tube was threaded through a hole in one end. After adding each 300-cc aliquot of water, the end of the lavage tube was lowered three feet below the bag and the fluid was siphoned out.

Six commonly used tablets and capsules were selected (Table). For each trial, a single tablet was placed in the artificial stomach and lavage was continued at the rate of one complete cycle per minute until it was estimated that essentially all the medication had been removed. The washed-out gelatin capsules sometimes never dissolved completely, and their removal was not considered in determining the results.

During half the trials there was no mechanical agitation of the artificial stomach. The lavage fluid simply flowed in and then was siphoned out (columns

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Table
TIME REQUIRED TO REMOVE MEDICATION FROM STOMACH MODEL (MIN)

Medication	A Cold Water Alone	B Warm Water Alone	C Cold Water Massage	D Warm Water Massage
Bufferin® 5-grain tablet	> 90*	35	4	3
Dalmane® 30-mg capsule	> 90*	44	29	8
Phenobarbital 60-mg tablet	21	13	9	7
Elavil® 100-mg tablet	56	12	13	7
Valium® 5-mg tablet	61	33	9	5
Darvon® 65-mg capsule	> 90*	18	20	2
Average	> 68	26	14	5.3

*Essentially no medication removed after 90 lavages.

A and B). During the remaining trials (columns C and D), a simple downward pressure was applied to the artificial stomach with the investigator's hand at the rate of one compression every two seconds.

This simple motion was used because we think it can be simulated in the live human subject by repetitive external pressure on the epigastrium. The compressions were performed only during the siphoning phase, and a single individual can still execute the lavage relatively easily.

The lavages were carried out with tap water of two different temperatures (Table). The results shown in columns A and C were obtained with water at 22 C (room temperature). The results shown in columns B and D were obtained with water at 46 C. Water at this temperature is the warmest in which it is comfortable to keep one's hand submerged.

RESULTS

It was extremely difficult to remove nearly all the medications tested with cold water and no mechanical agitation (Table). The relatively insoluble pill fragments settled to the bottom of the bag during each siphoning process without mov- [illegible] was positioned immediately adjacent to the pill fragments, the suction created was insufficient to remove them.

Comparing the average time at the bottom of column A (more than 68 minutes) with the average time in column B (26 minutes), it is evident that the use of warm water provided more rapid dissolution than did cold water ($P < 0.025$). Comparing the average time in A (more than 68 minutes) with the average time in column C (14 minutes), it is even more clear that mechanical agitation was of value ($P < 0.005$).

The use of both warmth and mechanical agitation was most impressive of all. The average time for removal of the medication using cold water without massage was more than 68 minutes. The average time for removal using both warm water and massage was only 5.3 minutes ($P < 0.005$). The differences were dramatic with every type of medication tested, whether in tablet or gelatin capsule form.

DISCUSSION

Applicability of Study

It is probable that in the majority of overdose patients the combined effects of gastric acid, peristalsis, and warmth result in complete dissolution of medication before the lavage

the traditional lavage technique ing room temperature fluid and massage may be adequate.

We suspect, however, that th are many overdose victims who h not had complete dissolution of me cation when they first present to t emergency department.[7] Many thors have described large masses undissolved medication in the sto ach, even after lavage.[4,8-11] In p ticular, iron, barbiturates, glute imide, meprobamate, and aspi have been reported to form conc tions of tablets that have been fou at autopsy[12] and occasionally quired surgical removal.[8,13]

Except in the unusual case which medication is radioopaque, emergency physician has no me available to determine if there is dissolved medication remaining the patient. It seems reasonab therefore, to use a procedure in patients which will have the b chance of removing undissol medication.

Model

The use of a plastic bag to re sent the stomach may at first se simplistic. One theoretical object is that the bag contains no hy chloric acid. We believe, howe that the presence of hydrochl acid is important only before the age process is begun. The effect gastric acid are probably mini during the lavage when large umes of water are moving into out of the stomach.

Another objection might be lavage fluid could be warmed sig cantly inside a live subject, ma use of prewarmed water unnecess Therefore, in a separate experi (not published) we measured temperature of lavage fluid ret ing from the stomach of a live man subject. During the first la cycle, the lavage fluid temperat increased from 22 C to only 2 During subsequent lavages the t perature increase was even less.

A third possible objection to use of our plastic bag model migh its lack of rugae. However, the ence of folds and crevices likely to make removal of m using conventional lavage even difficult. Thus the use of warm w and mechanical agitation migh even more important in an a stomach.

For these reasons, we think plastic bag is an adequate ex

dissolved medication. This model has the important advantage of allowing observation of the actual lavage process. We would encourage physicians to perform an abbreviated version of this experiment for themselves. The results are easily reproducible and the ineffectiveness of cold water lavage without agitation is striking.

RECOMMENDATIONS

We think a reasonable approach in overdose patients is to initially perform gastric lavage in the conventional manner with small (200-cc to 300-cc) aliquots of fluid until the return is clear. Instead of terminating the procedure at this point, we recommend using several additional lavages with external massage and progressively larger aliquots of up to, perhaps, 500 cc. A bag of saline can be placed in a sink full of warm water while the first phase is in progress. The warmed saline will then be ready for use during the second phase of the lavage without delaying the procedure.

Aliquot Size

In a study in small (14-kg to 18-kg) dogs, Fane[14] showed that aliquots as large as 200 cc (equivalent to perhaps 800 cc in adult humans) might be preferable to smaller aliquots. The pressure inside the stomach does not increase significantly until it is filled to over 1,000 cc.[15] Distention of the stomach actually inhibits stomach contractions,[15] and epigastric massage may be more effective when the stomach is larger.

The theoretical possibility of pushing medication through the pylorus with the larger aliquots and external massage must be considered. However, because the lavage would otherwise have been terminated before the use of larger aliquots and external massage is even begun, there would seem to be little to lose with the addition of this second phase to the lavage process.

The theoretical possibility of esophageal reflux with larger aliquots and massage makes endotracheal intubation even more important than it is ordinarily. Another possible disadvantage may be loss of excess hypotonic fluid through the pylorus.[16] This objection can be eliminated by using normal saline instead of tap water.

Lavage Fluid Warming

In both animals and man, the stomach emptying time for solid matter is delayed significantly with concomitant ingestion of warm water as opposed to cold.[17] Routine use of warm water lavage in poisoning cases was recommended by Ritschel and Erni in 1977[17] for this reason alone. Thus warmed lavage fluid is advantageous for three reasons: it prevents hypothermia; it dramatically increases the rate of dissolution of medications; and it decreases gastric peristalsis and potential loss of medication through the pylorus.

Epigastric Massage

Bartecchi[6] originally described the use of external gastric massage in 1974. He recommended placing the patient in the supine position with the hips flexed in order to achieve maximal abdominal wall relaxation. We recommend the left lateral decubitus position with the hips flexed, because it would seem that reflux through the pylorus is less likely in this position. Otherwise, our recommendations are similar.

Bartecchi described a case report in which conventional massage was performed on an aspirin overdose patient until the return was clear. He was subsequently able to obtain large amounts of cloudy white sediment and small bits of pill-like material by continuing the lavage procedure in conjunction with abdominal massage.

In most cases, the increased effectiveness obtainable with epigastric massage will not be as evident as it was in Bartecchi's case report.[7] Aspirin is removed during the lavage process by forming a particularly visible suspension of particles. Most of the other medications tested were actually dissolved during the lavage process, and thus were not generally visible.

The ineffectiveness and sporadic results using conventional lavage technique have been well documented.[18-20] The techniques described here may require a small amount of additional effort, but we believe they may be critical to effective gastric lavage in the common situation in which the ingested medication has not entirely dissolved before lavage is started.

CONCLUSION

We recommend that gastric lavage for poisoning victims be carried out in two stages. The first stage involves conventional lavage techniques, and the second involves the use of warmed lavage fluid, progressively larger aliquots of fluid, and external massage of the epigastrium.

Unfortunately, there are few studies that have investigated the parameters of lavage fluid temperature and external gastric massage.[6,7,17] Investigations in live animal or human subjects would be helpful in supporting our contentions, and we hope this study will stimulate further research.

Until additional information is available, we advocate the use of the modifications described. The results of our study suggest that whenever undissolved medication is present in the stomach, repetitive compressions of the epigastrium, together with the use of warmed lavage fluid, may substantially increase the effectiveness of gastric lavage.

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