Management of Acutely Poisoned Patients Without Gastric Emptying

During an 18-month period, 592 acute oral drug overdose patients were studied prospectively in a controlled, randomized fashion to determine the efficacy of gastric emptying procedures in altering clinical outcome. Patients presenting on even-numbered days had no gastric emptying procedures performed, and they were compared to patients presenting on odd-numbered days who received either syrup of ipecac or gastric lavage. Patients were carefully followed for evidence of subsequent clinical improvement or deterioration after initial management. Syrup of ipecac did not significantly alter the clinical outcome of patients who were awake and alert on presentation to the emergency department (ED). Gastric lavage in obtunded patients led to a more satisfactory clinical outcome (P < .05) only if performed within one hour of ingestion. Gastric emptying procedures in the ED for initial treatment of drug overdose are generally not of benefit unless gastric lavage is performed within one hour of ingestion in obtunded patients. [Kulig K, Bar-Or D, Cantrill SV, Rosen P, Rumack BH: Management of acutely poisoned patients without gastric emptying. Ann Emerg Med June 1985;14:562-567.]

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INTRODUCTION

In the initial management of acute, oral drug overdose, the issue of which gastric-emptying procedure is superior (ipecac-induced emesis or gastric lavage) has been studied extensively[1-4] but without satisfactory conclusion. Because we observed that 1) most adult overdose patients do not present to the emergency department (ED) until several hours after ingestion; 2) the use of syrup of ipecac greatly delays the subsequent administration of activated charcoal; and 3) gastric-emptying procedures may be associated with significant morbidity, we attempted to determine if emptying the stomachs of overdose patients using either method is beneficial.

The concept of deleting gastric emptying after drug overdose is not new.[5-7] Our study examined the question by following in detail the clinical course of a large number of patients who had taken an acute oral drug overdose. By randomizing patients according to the date of presentation into those who had gastric emptying performed and those who did not, we drew conclusions about the efficacy of the procedures in altering the subsequent clinical course.

METHODS

All patients who presented to the ED of Denver General Hospital between June 1981 and December 1982 (18 months) with the initial diagnosis of oral drug overdose were eligible for the study. Patients were excluded from the study if 1) emesis occurred spontaneously or after the administration of activated charcoal; 2) ipecac had been administered prior to arrival; 3) the ingested poison was a hydrocarbon, corrosive, iron, strychnine, or if acetaminophen was ingested alone (because of the potential problem of charcoal adsorbing the antidote); or 4) ethanol alone had been ingested.

All patients were entered into one of four protocol groups depending on the date of presentation and the initial mental status (Figure). Patients arriving on odd-numbered days were treated in the traditional manner by receiving either syrup of ipecac (Group 1) or by gastric lavage with a 30- to 40-French orogastric hose (Group 3), depending on the mental status at the time

Fig. *Protocol groups for gastric-empty-ing study; patients randomized according to date of presentation. Patients who were alert and cooperative received syrup of ipecac and activated charcoal (Group 1) or oral activated charcoal alone (Group 2). Obtunded patients were placed in either Group 3 (received gastric lavage and charcoal) or Group 4 (activated charcoal by nasogastric tube without lavage). All patients received activated charcoal, a magnesium sulfate cathartic, supportive care, and observation. Only patients in Groups 1 and 3 (presented on odd-numbered days) had a gastric-emptying procedure performed.*

Odd-numbered days —
Gastric emptying

Even-numbered days —
No gastric emptying

Patient alert, cooperative

(1) Syrup of ipecac, activated charcoal

(2) Oral activated charcoal only

Patient obtunded, convulsing, intubated, uncooperative

(3) Gastric lavage, activated charcoal

(4) Activated charcoal by nasogastric tube without lavage
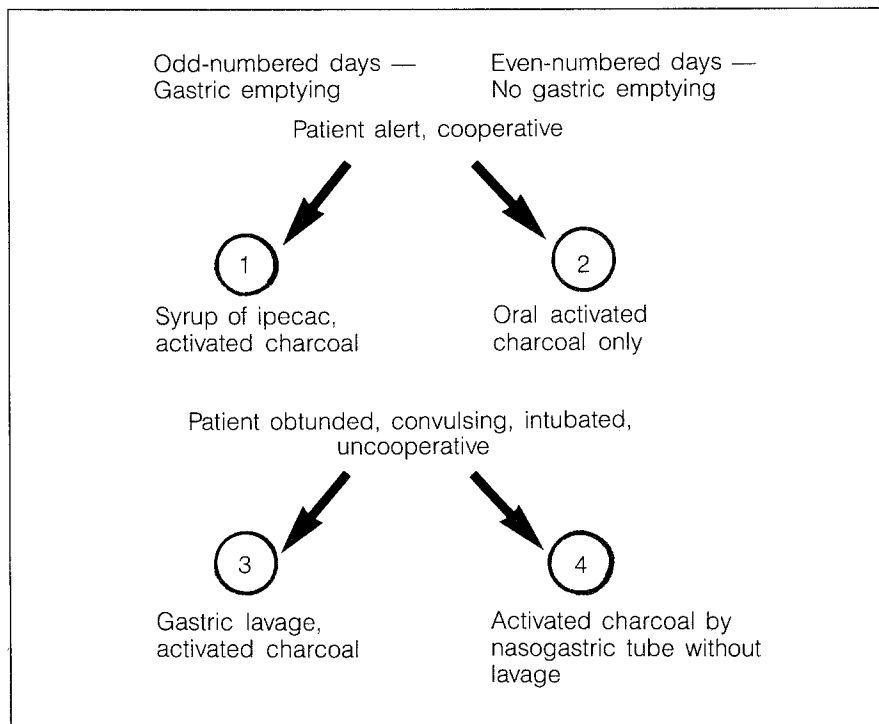
of presentation. Gastric lavage was performed using 250-mL aliquots of tap water until the return was clear, and it was performed routinely without prior intubation in patients who did not require airway support. Patients in both groups then received activated charcoal, 30 to 50 g mixed into a slurry with 20 g magnesium sulfate (or 250 mg/kg for a child) and water.

Patients presenting on even-numbered days did not undergo gastric-emptying procedures, but only received activated charcoal and the cathartic either orally (Group 2) or by nasogastric tube without prior aspiration or lavage of gastric contents (Group 4). All patients were monitored, and they received vigorous supportive care if needed, including airway support, ventilation, antidotes, anticonvulsants, antiarrhythmics, and pressors. All patients received activated charcoal and a cathartic, and all patients except those admitted to the intensive care unit (ICU) after stabilization were observed for a minimum of six hours in the observation unit of the ED.

Most patients who were eventually discharged from the ED were monitored for much longer periods of time, in some cases up to 24 hours. Patients who deteriorated clinically were admitted to the ICU, as were those who presented initially with severe symptomatology.

ED data were collected on a standard toxicology form created for our study, which detailed the patient's history, physical examination, laboratory data, and clinical course. This information, along with the entire medical record, was used as a basis for determining the severity of the overdose

and the direction of the clinical course. Based on both the ED and admission records (when applicable), patients were placed into one of three classifications (mild, moderate, severe) before and after initial ED management and when the maximum symptomatology was achieved during either the hospital or prehospital course). In cases of uncertainty, the responsible physician was contacted to clarify the clinical assessment.

Patients were considered to be mildly intoxicated if they were nauseated; ataxic; had slurred speech; were lethargic but easily arousable; had tinnitus (salicylates); or were tachycardic only (eg, secondary to an anticholinergic or sympathomimetic drug). Asymptomatic patients also were placed in this category.

Patients classified as moderately intoxicated included those who were obtunded and difficult to arouse but who did not require intubation; those who had protracted vomiting or diarrhea; and those who developed renal, hepatic, or hematologic abnormalities as a result of the overdose.

Patients were classified as severely intoxicated if they required airway support; were hypotensive (systolic BP less than 90 mm Hg); convulsed; had significant acidosis (serum bicarbonate < 18 mEq/L or pH < 7.30); had a

toxic psychosis; developed renal or hepatic failure; had dysrhythmias other than sinus tachycardia; or developed pulmonary edema.

This classification allowed us to demonstrate effective randomization of similar patients and to determine clinical improvement or deterioration after initial management. For example, patients who presented with a mild intoxication and subsequently developed a moderate or severe intoxication after ED treatment were judged to have deteriorated. Conversely patients who presented as moderate or severe intoxications and who became only mildly intoxicated after initial treatment were judged to have improved clinically.

Data were analyzed statistically by chi-square analysis. Comparisons were considered significantly different at $P < .05$.

Our study was approved by the Human Research Committee of Denver General Hospital.

RESULTS

Six hundred thirty patients met the criteria and were entered into one of the four treatment groups. Not included were seven patients deliberately removed from the study by the attending physician; these patients were critically ill and were lavaged

TABLE 1. *Severity of intoxication according to treatment group**

Severity	Group Comparisons	Significance
Mild	Group 1 (192) vs Group 2 (228)	NS†
	Group 3 (25) vs Group 4 (16)	NS
Moderate	Group 1 (19) vs Group 2 (31)	NS
	Group 3 (26) vs Group 4 (11)	NS
Severe	Group 1 (3) vs Group 2 (3)	NS
	Group 3 (21) vs Group 4 (17)	NS

*Effective randomization achieved; total number of patients in each group in parentheses.
†Not significantly different by chi-square analysis $(P > .05)$.

TABLE 2. *Patients admitted, by protocol number*

Group	N	No. Admitted (%)	
1	214	14 (6.59%)	NS*
2	262	19 (7.25%)	
3	72	27 (37.50%)	NS
4	44	19 (43.18%)	
Total	592	79 (13.34%)	

*Not significantly different by chi-square analysis $(P > .05)$.

TABLE 3. *Patients considered to have clinically deteriorated after initial ED presentation*

Group	N	No. Clinically Deteriorating (%)	
1	214	3 (1.40%)	NS*
2	262	2 (0.76%)	
3	72	16 (22.22%)	NS
4	44	12 (27.27%)	
Total	592	33 (5.57%)	

*Not significantly different by chi-square analysis $(P > .05)$.

outside of the randomized protocol. Thirty-eight patients initially were entered into the study, but they were not treated correctly according to the randomized protocol. These were either Group 1 patients who did not receive ipecac, or patients in any group for whom the administration of activated charcoal was not documented.

Of the 592 patients treated according to protocol, there were 214 in Group 1, 262 in Group 2, 72 in Group 3, and 44 in Group 4. Effective randomization by the odd-even day system was demonstrated by chi-square analysis for both the total number of patients in the gastric-emptying ver-sus no-gastric-emptying groups (286 vs 306) and for like patients in Groups 1 and 2 (214 vs 262) and Groups 3 and 4 (72 vs 44).

The mean age of the 592 patients was 29.3 years, with a range of 8 months to 80 years. There were five patients under 5 years of age (patients presenting to the pediatric walk-in clinic at Denver General Hospital were not included), and eight patients older than 60 years. There were 268 male patients and 324 female patients.

Only like groups (1 vs 2; 3 vs 4) were compared. That is, only patients who were alert on presentation to the ED were treated in protocols 1 and 2

(Figure) and could be considered comparable. Patients who were obtunded on presentation (Group 3 or 4) were not compared to awake patients (Group 1 or 2), and therefore no attempt was made to determine the relative efficacy of ipecac versus lavage.

When Groups 1 versus 2 (awake and cooperative patients) and Groups 3 versus 4 (obtunded patients) were compared according to severity of intoxication at any time during the clinical course (Table 1), randomization was demonstrated by the fact that no group had a significantly greater number of "more toxic" patients than its comparison group. Severity of intoxication for this purpose was determined by the maximum severity of symptomatology and clinical findings at any time during the patient's pre-hospital or hospital course.

In patients for whom the time of overdose could be ascertained (N = 472), the mean time from ingestion to arrival in the ED was 3.3 hours (range, 15 minutes to 18 hours). For Group 1 patients (patients receiving both syrup of ipecac and activated charcoal), the administration of charcoal was delayed by 2.2 hours (range, 1 to 6.5 hours). The total number of medical admissions in the study (psychiatric admissions excluded) was 79 (13% of 592 patients treated according to protocol) (Table 2). The number of admissions of Group 1 patients was not significantly different from the number of admissions of Group 2 patients (P = 0.091). There also was no statistical difference in the number of Group 3 and Group 4 patients admitted (P = 0.368). The number of patients who were considered to have clinically deteriorated after presentation to the ED is shown (Table 3).

Patients for whom the time of ingestion could be determined accurately (N = 472) have been subdivided into those presenting within one hour of ingestion and those presenting after one hour (Table 4). Comparison of like groups (1 vs 2; 3 vs 4) demonstrates only one statistically significant difference: obtunded patients who were lavaged and then given activated charcoal within one hour of ingestion had a more satisfactory clinical course than did identical patients who were given charcoal by nasogastric tube only (P < .05). The converse, however, is not true; that is, the deletion of gastric lavage did not result in a significantly greater number of patients who

TABLE 4. *Patients, by clinical course*

	Total		$\leq$ 1 Hr to ED			> 1 Hr to ED	
Improved							
1 vs 2	(211 vs 260)	NS*	(51 vs 67)	NS		(132 vs 147)	NS
3 vs 4	(56 vs 32)	NS	(16 vs 3)	$P < .05$		(20 vs 14)	NS
Deteriorated							
1 vs 2	(3 vs 2)	NS	(0 vs 0)	NS		(3 vs 2)	NS
3 vs 4	(16 vs 12)	NS	(1 vs 2)	NS		(8 vs 6)	NS
*Not significantly different by chi-square analysis.							

clinically deteriorated (Group 4 vs Group 3).

Although it would be desirable to analyze the data by looking at individual toxins, the resulting numbers become too small to lead to meaningful conclusions. For example, tricyclic antidepressants were ingested by 45 patients in the study (7.6% of 592 patients), resulting in 15 ICU admissions (19% of 79 admissions in our study). Of the 34 patients for whom the time of overdose was known, 14 patients presented within one hour of the ingestion and 20 patients presented after one hour. Further subdivision into severity of intoxication does not result in numbers large enough to be statistically meaningful.

Our initial impression that gastric-emptying procedures are not necessarily safe was confirmed by two cases in the study. A 69-year-old man who had overdosed on meprobamate and ethanol developed an esophageal perforation subsequent to endotracheal intubation and gastric lavage, requiring major surgery and a complicated hospital course. A 36-year-old man who had ingested a large quantity of phenobarbital was given syrup of ipecac because he was awake and alert at the time of administration. The patient subsequently became obtunded, then vomited, resulting in a severe aspiration pneumonitis and a prolonged hospital course.

There was only one death in this series, a 68-year-old woman who died of hepatic failure after an acetaminophen overdose. The patient had been lavaged and given activated charcoal in the ED, but the acetaminophen overdose had not been recognized for days because of inability to obtain a history and because acetaminophen analysis was not performed.

Other epidemiologic data of interest include the number of drugs ingested and the drugs resulting in the greatest number of admissions. Of the 592 patients, 231 (39%) ingested only one drug by history; 254 (42.9%) ingested two drugs; and 107 (18.1%) ingested three or more, including five patients who each had ingested seven different drugs. Although patients who had ingested ethanol alone by history and by clinical assessment were not considered candidates for the study, ethanol was considered a coingested drug if it was detected by blood analysis. Of all patients, 251 (42.4%) had ethanol as a coingestant.

Of the 79 patients admitted to the ICU, eight types of drugs accounted for 53 admissions (67%): tricyclic antidepressants (15); barbiturates (8); phenothiazines/haloperidol (6); narcotics (6); salicylates (5); beta blockers (5); phenytoin (4); and sedative-hypnotics (4). The relatively small number of hospital admissions was in large part due to the presence of an observation unit in the ED, where patients were monitored and treated for at least six hours, and in some cases for as long as 24 hours.

DISCUSSION

Many problems inherent in the study of human drug overdoses make it difficult to determine the optimum method of initial management. Studies in human volunteers ethically cannot examine overdose quantities of drugs, and studies in experimental animals (usually anesthetized) are not comparable to the clinical situation seen in the ED. For these reasons we felt that only by examining a large number of actual cases of drug overdose could we make conclusions about the efficacy of gastric-emptying procedures.

The parameters we evaluated were solely clinical because the only question we attempted to answer is: Does gastric emptying alter clinical course? We did not attempt to compare serum levels or gastric content levels of ingested drugs because of the difficulties in comparing results obtained from such a heterogeneous population and because such results would not have answered the question posed here concerning clinical outcome.

Perhaps the primary reason why our results did not demonstrate a beneficial effect of gastric emptying in most cases is that our patient population consisted primarily of suicidal adults who tended to come to the hospital only after many hours had elapsed since ingestion. The mean time from ingestion to hospital presentation in our study (3.3 hours) is quite different from that seen when children are studied (68 minutes).[8] Our findings are more consistent with one epidemiologic study of adult overdose patients, which found that 39 of 82 (48%) presented more than two hours after ingestion.[9]

Thus, although syrup of ipecac will cause emesis in the vast majority,[3,8,10-13] the amount of toxin removed is probably insignificant. Ipecac-induced emesis has been shown to have no significant effect on the bioavailability (area under the serum concentration-time curve) of paracetamol and aminophylline if given even 30 minutes after ingestion in human volunteers.[13] Although the same study demonstrated some decrease in the bioavailability of tetracycline, the decrease in the area under the curve seen with administration of activated charcoal was significantly greater than that of ipecac, whether given at five or 30 minutes postingestion.

Children given a magnesium hy-

droxide marker *immediately* prior to administration of ipecac vomited a mean of only 28% ± 7% of the marker (range, 0% to 78%).[14] Marker recovery after a delay in ipecac administration, more closely mimicking the actual overdose situation, was not evaluated in our study. Another study in children compared the relative amounts of salicylate removed from the stomach by ipecac-induced emesis or lavage with a nasogastric tube.[3] Although the authors concluded that ipecac was superior, the mean amount of salicylate removed by either method was less than one-half of one adult (325-mg) tablet!

A more recent study performed in volunteers examined the relative efficacy of ipecac, ipecac plus charcoal and a cathartic, and charcoal and a cathartic alone in reducing the absorption of multiple aspirin tablets.[15] The authors concluded that charcoal and a cathartic administered alone, without inducing emesis first, was superior to the other treatment modalities in this simulated overdose model.

Experimental animal data also would imply that syrup of ipecac, even given very soon after overdose, is inefficient in removing poison from the stomach.[1] Ipecac given at 0, 30, or 60 minutes after administration of a barium marker in dogs recovered means of 62%, 44%, and 26% of the marker, respectively. After administration of a salicylate overdose to dogs and ipecac 15 minutes later, average recovery of salicylate in the emesis was 39% (range, 5% to 74%).[2] Also using dogs, it was shown that ipecac given 20 minutes after a barium marker recovered only 19% ± 9% (range, 2% to 31%) of the marker.[4] Extrapolating the data from these studies to human overdoses requires a great deal of subjective interpretation. Nonetheless, it appears that in the prevention of toxin absorption, syrup of ipecac is not very effective.

The length of time that administration of syrup of ipecac delays the subsequent administration of activated charcoal has not been determined previously. Human volunteers given syrup of ipecac have demonstrated that the emetic effect lasted for a mean of 4.2 ± 0.6 hours (range, 2 to 8 hours).[13] Our study did not assess total time of emesis, but rather it demonstrated that in patients who received both ipecac and charcoal (Group 1), the mean time until administration of

charcoal was 2.2 hours (range, 1 to 6.5 hours).

The importance of this figure can be seen when one reviews the literature on the effectiveness of activated charcoal in not only preventing drug absorption, but also enhancing the elimination of drugs already absorbed into the blood. Extensive reviews of the properties of activated charcoal are numerous,[16-21] and they have concluded that activated charcoal is very effective in preventing drug absorption. As early as 1963, Holt and Holz stated that, "Of the emergency measures it is our belief that charcoal is probably the most effective single measure because of its broad spectrum of activity and its exceedingly rapid inactivation of the poison."[22] More recent studies also have demonstrated that administration of activated charcoal into the gastrointestinal tract can increase the elimination rate of drugs already absorbed or given intravenously. This property of "gastrointestinal dialysis"[23] has been demonstrated for theophylline,[24,25] phenobarbital,[26-28] carbamazepine,[28] phenylbutazone,[28] dapsone,[29] digitoxin,[30] and nadolol.[31]

If we assume that the relative value of activated charcoal is greater than the relative value of induced emesis using syrup of ipecac, the clinician treating the overdose patient must ask: Is it beneficial to delay the administration of activated charcoal by several hours in order to induce emesis?

The use of gastric lavage, as opposed to syrup of ipecac, should not delay considerably the time before administration of activated charcoal. The primary concern is whether lavage is effective in removing ingested toxin and whether it alters clinical outcome.

Previously cited studies have concluded that lavage is even less efficacious than syrup of ipecac in recovering gastrointestinal markers in experimental animals[1,2,4] and human beings.[3] These studies have been criticized[32-34] for using a small-diameter nasogastric tube instead of the larger orogastric hose that is commonly used today.

Comstock and colleagues[35] have evaluated the lavage recovery (34-French gastric tube) in a population of overdose patients selected for lavage in a nonrandom fashion, and they determined that among patients ingest-

ing short-acting barbiturates, phenobarbital, or methaqualone, only 12 of 76 patients (15.8%) had more than two therapeutic doses of the drugs recovered by gastric lavage. In addition, 27 of 76 patients (35.5%) demonstrated continued drug absorption as shown by rising serum levels after gastric lavage.

In our study, gastric lavage performed with a large orogastric hose (36 to 40 French) did not affect clinical outcome when performed more than one hour postingestion. In the obtunded patient, gastric lavage performed within one hour of ingestion resulted in a more favorable outcome ($P < .05$) as noted by a greater number of cases of clinical improvement after initial treatment.

Although gastric lavage appeared to be valuable in at least one subset of patients, and ipecac-induced emesis did not, we can make no conclusions about the relative value of emesis versus lavage. This controversy was not examined in our study because awake patients were not lavaged and compared to those receiving ipecac.

It also is possible that the activated charcoal and cathartic administered in this study as a single dose did not significantly affect the clinical outcome. This conclusion must await further clinical studies that include an "observation only" group of patients.

CONCLUSIONS

Our conclusions are the following:

1) A satisfactory clinical outcome can be achieved in drug overdose patients without gastric emptying procedures being performed routinely.

2) The use of syrup of ipecac in the ED is not of benefit in patients who present hours after an oral drug overdose;

3) Gastric lavage in obtunded patients is of questionable value if the ingestion occurred more than one hour before ED presentation; and

4) Mandatory gastric emptying as initial treatment of all drug overdose patients should not be the accepted standard of care; in most cases the administration of activated charcoal and vigorous supportive care are sufficient treatment.

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