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Position Paper: Gastric Lavage

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POSITION PAPER

Position Paper: Gastric Lavage[#]

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ABSTRACT

Gastric lavage should not be employed routinely, if ever, in the management of poisoned patients. In experimental studies, the amount of marker removed by gastric lavage was highly variable and diminished with time. The results of clinical outcome studies in overdose patients are weighed heavily on the side of showing a lack of beneficial effect. Serious risks of the procedure include hypoxia, dysrhythmias, laryngospasm, perforation of the GI tract or pharynx, fluid and electrolyte abnormalities, and aspiration pneumonitis. Contraindications include loss of protective airway reflexes (unless the patient is first intubated tracheally), ingestion of a strong acid or alkali, ingestion of a hydrocarbon with a high aspiration potential, or risk of GI hemorrhage due to an underlying medical or surgical condition. A review of the 1997 Gastric Lavage Position Statement revealed no new evidence that would require a revision of the conclusions of the Statement.

SUMMARY STATEMENT

Introduction

- Overall, the mortality from acute poisoning is less than one percent, and the challenge for clinicians managing poisoned patients is to identify promptly those who are most at risk of developing serious complications, and who might therefore potentially benefit from gastrointestinal decontamination.

Rationale

- Gastric lavage involves the passage of a large bore orogastric tube and the sequential administration and aspiration of small volumes of liquid, with the intent of removing toxic substances present in the stomach. This Position Paper does not review the use of a small bore nasogastric tube when used only to aspirate stomach contents or to administer activated charcoal.

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Animal Studies

- Three studies have been performed in animals and none has demonstrated substantial drug recovery, particularly if lavage was delayed for 60 minutes.
- If gastric lavage was undertaken within 15–20 minutes of dosing, the mean recovery of marker was 38% (1) and 29% (2). When lavage was performed at 30 minutes, the mean recovery was 26% (3). Gastric lavage undertaken at 60 minutes resulted in mean recoveries of 13% (1) and 8.6% (3).

Volunteer Studies

- Early volunteer studies have provided insufficient support for the clinical use of gastric lavage, and the recovery of marker was highly variable when lavage was undertaken less than 20 minutes after dosing. When performed at 5 minutes, the mean recovery of marker was 90% ($p<0.001$) (4); when performed at 10 minutes, the mean recovery of marker was 45% ($p<0.005$) (5), and when gastric lavage was undertaken at a mean time of 19 minutes, the mean recovery was 30.3% (6).
- In the studies performed at 60 minutes post-dosing, the mean reduction in area under the curve (AUC) was 32% (NS) in one study (7) and in the second (8) the mean reduction in salicylate excretion was 8% ($p<0.025$).
- More recent studies have used a combination of drugs as markers to examine the efficacy of lavage. When lavage was performed 5 minutes after nine volunteers ingested temazepam 10 mg, verapamil 80 mg and moclobemide 150 mg, the AUC (0,24 h) was reduced by 25.6%, 4%, and 32.2% respectively, none of which were statistically significant (9). When the same marker drugs in the same doses were ingested by nine volunteers, and gastric lavage was performed 30 minutes later, lavage reduced the AUC (0,24 h) of temazepam by 17.6% (NS), verapamil by 33.2% (NS), and moclobemide by 44% ($p<0.05$) (10). Nine volunteers ingested diazepam 5 mg, ibuprofen 400 mg, and citalopram 20 mg simultaneously, and then 30 minutes later received water 200 ml (control group), charcoal 25 gm in 200 ml water, or lavage followed by charcoal. The combination of gastric lavage and activated charcoal reduced the AUC (0,10) of diazepam by 27% ($p<0.05$), of ibuprofen by 49% ($p<0.05$), and citalopram by 51% ($p<0.05$) (11). These decreases were not significantly different than those seen after charcoal alone.
- Volunteer studies with lavage have usually used tablets, but one study employed liquid acetaminophen 4 gm as the marker, with gastric lavage being performed one hour after ingestion (12). The mean AUC decreased by 20%±28%, which was statistically significant, but the authors concluded their data demonstrated that lavage would be of unlikely clinical benefit.
- One study suggested that lavage may propel material into the small intestine, thus increasing the possibility of enhanced drug absorption (13). A re-analysis of that data disputes that claim (14). In a different study, volunteers drinking radio-labeled tap water were lavaged 5 minutes later, and three different lavage techniques reduced the amount of radioactive material subsequently found in the small bowel (15).

Clinical Studies

- Early clinical studies (16–18) did not demonstrate an alteration in outcome, although in some cases showed the removal of drug from the stomach by lavage. Gastric lavage became a common procedure in the Emergency Department in overdose patients on that theoretical basis.
- In the first study to compare clinical outcomes in overdose patients receiving either ipecac plus charcoal or lavage plus charcoal versus charcoal alone, clinical improvement after lavage was noted only in the small subset (16 lavage plus charcoal versus charcoal alone) of obtunded patients who presented within one hour of ingestion (19). The omission of gastric lavage did not result in clinical deterioration, thus undermining the validity of the improvement observation. Small group sizes and a methodological selection bias limit the conclusions that can be drawn from this study regarding gastric lavage specifically.
- In a follow-up study using a similar study design and analysis performed in Australia (20) benefit from gastric lavage was not demonstrated. There was no statistically significant difference in the numbers of obtunded, early presenting patients improving after lavage versus those receiving charcoal alone (5 vs. 0; $p=0.31$), nor in those deteriorating (5 vs. 2; $p=1.0$). These very small numbers of patients makes a conclusion of lavage

ineffectiveness questionable. 124 of the original 1,000 patients in this study were excluded from data analysis, while 82 did not receive the assigned protocol treatment.

- A third outcome study (21) is also difficult to interpret because patients undergoing gastric emptying procedures (either ipecac or lavage) were analyzed as one group. When so examined, the study did not demonstrate a clinical benefit of gastric emptying. Gastric lavage, however, was associated with a higher prevalence of ICU admissions and aspiration pneumonitis ($p=0.0001$ for each) compared to that of patients receiving charcoal alone.

Indications

- Based on experimental and clinical studies, gastric lavage should not be performed routinely, if ever. In certain cases where the procedure is of attractive theoretical benefit (e.g., recent ingestion of a very toxic substance), the substantial risks should be weighed carefully against the sparse evidence that the procedure is of any benefit.

Contraindications

- Loss of airway protective reflexes, such as in a patient with a depressed state of consciousness, unless intubated tracheally.
- Ingestion of a corrosive substance such as a strong acid or alkali.
- Ingestion of a hydrocarbon with high aspiration potential.
- Patients who are at risk of hemorrhage or gastrointestinal perforation due to pathology, recent surgery, or other medical condition such as a coagulopathy.

Complications

- The most common complication of lavage is aspiration pneumonia (21,22); in some patients this may be due to performing the procedure when the airway is unprotected. Perforation of the esophagus has been reported (18,19,23–25), and may be life threatening. Charcoal in the peritoneum presumably from GI perforation has also been reported (26). Larygospasm (16), and hypoxia and cardiac dysrhythmias (27) may occur. Fluid and electrolyte imbalance, particularly in children lavaged with water instead of saline, has also been reported (28).

SUPPORTING DOCUMENTATION

Introduction

- Gastric lavage has been employed widely for some 180 years to facilitate removal of poisons from the stomach. However, evidence of clinical benefit from lavage is lacking, and serious complications from the procedure have accumulated in the literature. Proudfoot (29) has nevertheless argued, ‘‘To advocate abandoning it (lavage) is to attack one of the very pillars of management of poisoning by ingestion and cannot be supported lightly. However, endorsement by common usage should not blind physicians to its limitations or prohibit it from critical appraisal.’’

Rationale

- Gastric lavage involves the passage of an orogastric tube and the sequential administration and aspiration of small volumes of liquid with the intent of removing toxic substances present in the stomach.

Animal Studies

- Experimental studies were undertaken, particularly in the 1960s, to provide support for the clinical reintroduction of gastric lavage both in Europe and North America. However, the results of gastric emptying studies in experimental animals require a degree of caution when extrapolating them to cases of human poisoning. Anesthetized animals are dissimilar to overdosed patients in several important ways. Animals are generally given anesthetic or analgesic agents that may slow gastrointestinal motility, are placed in a prone position, intubated and ventilated, and then administered an overdose of a single medication that may not be in the form of intact tablets (30). Moreover, the experimental studies fail to demonstrate that gastric lavage is of significant benefit even when undertaken within minutes after dosing. As most poisoned patients arrive at a treatment facility more than several hours after overdose, the clinical relevance of these experimental studies is even less certain.

Sodium Salicylate

The value of gastric lavage was investigated in fasted non-anesthetized dogs (6–10 kg) who were pretreated with chlorpromazine 25 mg or promethazine 25 mg IM or promethazine 37.5–50 mg IV to prevent spontaneous vomiting (1). Pretreatment occurred 30 minutes prior to the administration of sodium salicylate 500 mg/kg in broken tablet form. Lavage was undertaken via a 16 French gauge tube at 15 or 60 minutes after dosing. When lavage was performed at 15 minutes (n=46), a mean of 38% (range 2–69%) of the administered salicylate was recovered and when treatment was delayed for 60 minutes (n=24), a mean of only 13% (range 0–40%) was recovered.

Barium Sulfate

Abdallah and Tye (3) also studied the use of gastric lavage in non-anesthetized dogs (2.2–5.4 kg) using barium sulfate 5 g as a marker. The lavage tube had an outer diameter of 19 mm and lavage was undertaken either at 30 minutes (nine dogs) or 60 minutes (six dogs). Lavage led to a mean recovery of 1.3 g (SEM ± 0.29) barium sulfate at 30 minutes but only 0.43 g (SEM ± 0.2) at 60 minutes. The data represent mean recoveries of 26% and 8.6% at 30 and 60 minutes, respectively.

Gastric lavage was also investigated in six non-anesthetized fasting puppies using barium sulfate (2 g) as a marker (2). The diameter of the lavage tube was not stated, but tap water 100 mL was instilled into the stomach by nasogastric tube. Lavage at 20 minutes after dosing resulted in a mean recovery of 29 ± 10% (range 10–62%) of marker.

Aspirin

Six dogs (20–30 kg) were given aspirin 500 mg/kg 30 minutes before lavage was undertaken and activated charcoal (1.5 g/kg; a 3:1 ratio of charcoal to salicylate) was administered (31). Prior to lavage, acepromazine maleate 0.25 mg/kg was given intravenously as a sedative. Lavage was performed using a 34 French gauge lavage tube. A 37% reduction ($p<0.05$) in salicylate concentration at 4 hours post-ingestion was found when compared with controls, though the benefit resulting from the use of lavage alone is unknown.

Experimental Studies in Volunteers or Poisoned Patients

- Volunteer studies suffer from several basic limitations: it is difficult to extrapolate data from simulated overdoses in volunteers (with nontoxic doses) to poisoned patients (who may have ingested very large amounts) because the amount ingested may affect the dissolution and absorption of the drug or marker concerned. Furthermore, the time from ingestion to lavage is usually no more than 60 minutes, which makes extrapolation to overdose patients difficult as they usually present later to a treatment facility.
- Three studies (4,13,32) performed in poisoned patients are also included in this section since their design was experimental and precluded assessment of clinical benefit.

General Value of Lavage

An endoscopic study performed in 17 poisoned patients demonstrated that after lavage using a Faucher tube size 33, 88% of patients still had residual tablet or food debris in the stomach; 12 of 17 patients had tablet debris (32).

One study concluded that gastric lavage may cause gastric contents to be propelled into the small bowel, thereby potentially increasing the amount of drug available for absorption (13). In 20 poisoned patients who swallowed 20 polythene pellets 5 minutes before gastric lavage (water 3.5–6 L), 207 of 400 (51.8%) pellets were retained in the gut. Of these 69 (33.3%) were counted in the small intestine by radiographs performed at a mean time of 33 (range 10–90) minutes after pellet ingestion. When compared to a control group of 20 patients, there was a highly significant ($p<0.0001$) difference between the two groups in regard to the number of residual pellets in the small bowel (33.3% vs 16.3%). A re-analysis of these data led another group to dispute these findings, however (14). In a different study, volunteers drinking radiolabeled tap water were lavaged 5 minutes later. Three different lavage techniques (open single syringe method, closed gravity drainage system, and a closed double syringe method) reduced the amount of radioactive material found in the small bowel by 84 ± 13%, 80 ± 20%, and 83 ± 6%, all statistically different from controls but not from each other (15). 15 minutes later the controls had more radioactivity in the duodenum that in any of the lavage groups, indicating that lavage did not propel gastric contents into the small bowel.

Acetaminophen

Twelve volunteers were given acetaminophen (paracetamol) 50 mg/kg as 125 mg tablets (33). In one limb of the study they received activated charcoal 50 gm one hour later; in a second limb they were lavaged with an orogastric tube (30 English gauge) at one hour followed by charcoal; a third study limb was the administration of charcoal at 2 hours post ingestion. The mean decrease in AUC for one hour charcoal was 66%, for lavage at one hour then charcoal 48.2%, and for charcoal at two hours 22.7%. There was no significant difference between the group receiving lavage at one hour then charcoal, versus the group receiving charcoal at one hour without prior lavage. The authors concluded that the combination treatment may be no better than activated charcoal alone in patients presenting early.

Ampicillin

A mean 32% reduction in the AUC was noted after 10 fasting volunteers had been lavaged using a 34 French gauge orogastric tube 60 minutes after the administration of ampicillin 5 g as twenty 250 mg capsules (7). This reduction was not statistically significant.

Aspirin

Lavage performed using a 30 French gauge orogastric tube 60 minutes after administration of aspirin 1.5 g as twenty 75 mg tablets to 12 volunteers did not produce a clinically important reduction in the absorption of aspirin as judged by salicylate recovery in the urine (8). Mean (±SD) recovery of salicylate was 55.5% (±8.8) in the lavage group and 60.3% (±13.3) in the control group; this represents a reduction of only 8% by lavage. Salicylate excretion in the urine was followed for only 24 hours; whereas, if the period of urine collection had been extended to 48 hours, salicylate recovery could have been as high as 96% (34). Therefore, a greater difference between the lavage and control groups may have been observed (35). Moreover, the quantitative analytical method used underestimated some of the aspirin metabolites. In addition, neither the area under the plasma drug concentration-time curve (AUC) nor the peak salicylate concentration were measured so that the efficacy of lavage could not be assessed using standard kinetic calculations.

Combinations of Drugs as Markers

Nine volunteers ingested temazepam 10 mg, verapamil 80 mg and moclobemide 150 mg simultaneously and then were lavaged 5 minutes later. The AUC was reduced by 25.6%, 4%, and 32.2% respectively, none of which were statistically significant (9). When the same marker drugs in the same doses were ingested by nine volunteers, and gastric lavage was performed 30 minutes later, lavage reduced the AUC of temazepam by 17.6% (NS), verapamil by 33.2% (NS), and moclobemide by 44% ($p<0.05$) (10). Nine volunteers ingested diazepam 5 mg, ibuprofen 400 mg, and citalopram 20 mg simultaneously, and then 30 minutes later received 200 ml water (control group), charcoal 25 gm in water 200 ml, or lavage followed by charcoal. Lavage plus charcoal reduced the AUC of diazepam by 27% ($p<0.05$), of ibuprofen by 49% ($p<0.05$), and citalopram by 51% ($p<0.05$) (11). These decreases were not significantly different than those seen after charcoal alone.

Cyanocobalamin

Tandberg et al. (5) found that lavage with a 32 French gauge orogastric tube 10 minutes after the administration of cyanocobalamin (twenty-five 100 μg tablets [Note: this was a huge error—grams instead of micrograms]) as a marker resulted in a mean recovery of cyanocobalamin of 45±13% (range 19–68%). This study, however, has little relevance to clinical practice due to the very early use of lavage.

Tc^{99m}

Seventeen fasting volunteers ingested 30 gelatin capsules prepared with Tc^{99m} bound to sulfur colloid, a nonabsorbable radioactive marker (6). At a mean time of 19 minutes (range 9–42 minutes) later, gastric lavage was performed and the mean recovery of tracer was 30.3% (±SD 17.4). Wide subject-to-subject variation was noted.

Thiamine

Auerbach et al. (4) performed gastric lavage on 37 patients using a 24 French gauge Harris Flush Tube with additional drainage holes; 33 were drowsy or obtunded when the procedure was performed. Thiamine 100 mg (as a liquid preparation) was administered via the gastric tube 5 minutes before lavage was undertaken. The mean thiamine recovery at lavage was 90±34% of administered dose. The reason for some of the thiamine recoveries exceeding the maximum possible recovery was not explained adequately by the authors. It must be emphasized that since the time interval between marker administration and lavage was so short, and because of the use of a liquid marker, the extrapolation of these data to cases of poisoning is difficult.

Clinical Studies

General Value of Lavage

Continued absorption of drug after lavage is known to occur (17,36) and drug concretions may be found in the stomach (37,38) or at postmortem examination (39) even after gastric lavage.

Acetaminophen (Paracetamol) Poisoning

Underhill et al. (40) examined the value of gastric lavage using a 36 French gauge orogastric tube in limiting the absorption of acetaminophen in 14 patients admitted to two hospitals who were thought to have ingested this drug within the previous 4 hours. A control group of patients treated at one of these hospitals was included, though the control arm of the study was stopped at five patients because serum acetaminophen concentrations increased between the first and last samples drawn in four of these five patients. Blood samples for measurement of acetaminophen were taken prior to treatment, following treatment, and at 60, 90, and 150 minutes after the first sample. These data were presented graphically and the authors claimed, without including the relevant statistical analysis of gastric lavage treated vs no treatment groups, that the mean (±SD) percentage fall between the first (admission) and last plasma acetaminophen concentrations in lavaged patients was 39.33% (±14.67).

Barbiturate Poisoning

The value of gastric lavage was investigated by Harstad et al. (41) in 71 cases of barbiturate poisoning. In 40 of these cases, no barbiturate was recovered by lavage using water 10 L. In 86% of cases, less than 100 mg of barbiturate was recovered; in only two cases was more than 450 mg recovered. Approximately 2.4 L of fluid were retained by each patient and particles of charcoal added to the lavage fluid were later found in the lungs of those who died. The authors suggested that barbiturate absorption was increased by the procedure because drug was washed into the small bowel. In addition, as Matthew et al. (18) commented, Harstad et al. (41) estimated the amount of barbiturate recovered by an inaccurate analytical method which would give spuriously low readings for barbiturate.

Wright (42) found that in three of six cases lavaged within 4 hours of overdose, more than 200 mg of barbiturate were recovered while in six others treated more than 4 hours after overdose, less than 130 mg were retrieved.

The value of gastric lavage was reviewed by Allan (16) in 68 patients poisoned with barbiturates. Fifty-three were unconscious on admission to the hospital and were allocated to one of two groups. Twenty-five of the 53 had taken an overdose within 3 hours of admission (Group 1); the remainder were admitted more than 3 hours after the overdose (Group 2). Fifteen patients who were conscious on admission comprised Group 3. In Group 1, a mean of 220 mg of barbiturate were recovered; in Group 2 a mean of 110 mg were recovered, whereas only a mean of 39 mg were recovered in those conscious on admission. Although there were no complications in conscious patients or those who were deeply comatose with absent pharyngeal and laryngeal reflexes, temporary cyanosis occurred in 10 patients, nine of whom developed laryngeal spasm during attempted endotracheal intubation; five patients had evidence of gastric aspiration into the lungs. Since gastric lavage removed only small quantities of ingested barbiturate, Allan concluded that routine lavage of unconscious patients should be regarded as potentially dangerous in all cases and of no value in most.

Matthew et al. (18) analyzed the lavage specimens (between 2–7 L) of 259 poisoned patients who underwent gastric lavage with a large bore tube (Jacques 30 English gauge). Of the 148 patients who had ingested barbiturates, at least 200 mg of drug were recovered in 17% of cases. Sixty-five patients were lavaged within 4 hours of ingestion and in 37% of these cases, more than 200 mg of barbiturate were recovered, whereas in only one of 65 cases lavaged after 4 hours were more than 200 mg recovered. Overall, the best results for lavage were obtained from deeply unconscious patients, presumably reflecting the fact that unconscious patients were more severely poisoned and, therefore, had ingested more drug.

Jimson Weed

Salen et al. (43) described the use of 'nasogastric lavage' in 14/17 patients during an epidemic of jimson weed (*Datura stramonium*) seed abuse. Seeds were recovered in 8/14 (57%) of lavaged patients from 3–9 hours post ingestion, but there was no difference in ICU admission rates (p=0.68; specific numbers not reported) or length of stay in patients lavaged versus those not lavaged (25±18 hours versus 23±22 hours; p=0.85) The use of smaller (14–16 Fr.) nasogastric tubes and late performance of the procedure (3–9 hours) may make this study inapplicable to the use of gastric lavage in oral drug overdoses. There was no quantification of the number of seeds recovered versus the number that were ingested; further reducing the ability to determine the efficacy of lavage in these patients.

Salicylate Poisoning

Matthew et al. (18) analyzed the lavage specimens of 23 patients with salicylate poisoning. Lavage led to the recovery of more than 1000 mg of salicylate in only 6 of 23 cases.

In another study the value of lavage followed by emesis (with syrup of ipecac) was compared with emesis followed by lavage in children who were thought to have ingested aspirin (44). Significantly more (p<0.01) salicylate was recovered when emesis was performed prior to lavage though the amount recovered was small in most cases. However, the use of small bore nasogastric tubes limits the applicability to current practice.

Tricyclic Antidepressant Poisoning

In a study of eight patients who were moderately or severely poisoned with a tricyclic antidepressant, a mean of 94 mg (range 6–342 mg) of drug was recovered at lavage at a mean time of 2.5 hours in patients presenting less than 6 hours after overdose (45).

Unselected Cases of Poisoning

Comstock et al. (17) evaluated the efficacy of lavage using a 34 French gauge tube. In patients ingesting short-acting barbiturates (n=36) and phenobarbital (n=22), lavage yielded more than 10 therapeutic doses in 6% and 14% of cases, respectively. Lavage yielded more than 10 therapeutic doses of amitriptyline in 5 of 15 patients poisoned with this drug. Overall, in only 10 of 73 patients were more than 10 therapeutic doses of ingested drug recovered. The authors concluded that except in the case of tricyclic antidepressant poisoning and massive overdose, poor recovery of drug was likely if lavage was performed more than 2 hours after overdose.

The value of gastric lavage (30–40 French gauge orogastric tube) was compared in 72 obtunded patients who were lavaged and also received activated charcoal versus 42 patients who received activated charcoal alone (19). Gastric lavage and activated charcoal led to an improved clinical course in obtunded patients only in a subset of patients when lavage was performed within 60 minutes of ingestion (p<0.05). Clinical deterioration was not demonstrated in patients who were not lavaged. This early presenting, obtunded subset consisted of only 16 patients in the group who were lavaged within 60 minutes and then received charcoal, versus 3 patients in the comparative activated charcoal only group. Seven obtunded patients were excluded by the attending emergency physician as allowed by the protocol, a concession demanded by the Institutional Review Board. Conclusions about efficacy of lavage based on these data are limited.

Pond et al. (20) reported a prospective randomized, controlled trial involving 876 patients (a further 124 patients were excluded by defined criteria) more than 13 years of age who had ingested an overdose less than 12 hours previously; 184 of 876 (21%) patients were poisoned severely. All patients received activated charcoal and sorbitol (70%) 200 mL and the treatment groups were well-matched for age, sex, and severity of overdose, though the non emptying group received activated charcoal earlier (mean 55 minutes) than the gastric emptying group (mean 91 minutes). Obtunded patients (n=347) either underwent gastric lavage and received activated charcoal and sorbitol (n=209) or were administered activated charcoal and sorbitol alone (n=133); five patients defaulted from treatment. No significant difference in outcome between the gastric lavage group and the non-emptied group (p>0.05) was observed. However, the number of patients lavaged within one hour of their overdose was very small (improved 5 vs.0; p=0.31; deteriorated 5 vs.2; p=1.0). The authors concluded that gastric emptying can be omitted from the treatment regimen for adults after acute oral overdose, including those who present within 60 minutes of overdose and those who manifest severe toxicity.

A prospective study to evaluate the efficacy of gastric emptying in symptomatic patients was performed by Merigian et al. (21). Eighty-three patients underwent gastric lavage, two patients received lavage and syrup of ipecac, and 82 patients were given syrup of ipecac. All patients received activated charcoal 50 g after gastric emptying. The patients undergoing gastric emptying were compared to a group of patients who received either activated charcoal 50 g orally (alert patients) or activated charcoal 50 g administered via a nasogastric tube after aspiration of stomach contents. No data are available for each treatment group and there was considerable selection bias. The authors' conclusions that gastric emptying did not alter significantly the length of stay in the emergency department, mean length of time intubated, or mean length of stay in the ICU may therefore not be supportable. The use of gastric lavage and ipecac was associated with a significantly higher occurrence of aspiration pneumonia ($p<0.0001$) and admission to the ICU ($p<0.0001$).

Ardagh et al. (46) evaluated admission rates, ICU admission rates, and deaths over 4 different time periods (1999, 1996, 1992, and 1989) as the use of gastric lavage and activated charcoal declined (0.7%, 7%, 26%, and 53%), as well as the use of activated charcoal alone (13.2%, 54%, 46%, 0.4%). They concluded that although the trends in GI decontamination have changed dramatically over time, there has been no worsening in the outcome of patients with deliberate self-poisoning. These data are difficult to interpret regarding gastric lavage specifically.

Indications

- Experimental studies indicate that the amount of marker removed by gastric lavage is highly variable and diminishes with time. Clinical studies (19–21) have not confirmed the benefit of gastric lavage alone even when it was performed less than 60 minutes after poison ingestion. There are, however, descriptive reports that indicate that gastric lavage occasionally produces impressive returns. Based on experimental and clinical studies, gastric lavage has little potential benefit and, based on severity of potential complication, is a substantial risk. It should not be performed routinely, if ever. In extraordinary situations where the procedure seems to be a reasonable treatment option, the clinician should carefully examine that risk-benefit ratio and weigh it against the use of charcoal alone, or observation with supportive care and no gastrointestinal decontamination.

Contraindications

- Gastric lavage is contraindicated if the patient has an unprotected airway, such as in a patient with a depressed level of consciousness without endotracheal intubation. Gastric lavage is also contraindicated if its use increases the risk and severity of aspiration (such as a patient who has ingested a hydrocarbon with high aspiration potential). Patients who are at risk of hemorrhage or gastrointestinal perforation due to pathology, recent surgery or other medical condition, could be further compromised by the use of gastric lavage.

Complications of Lavage

- The potential complications of gastric lavage are well-documented, although serious sequelae appear to be uncommon.
- Aspiration pneumonia is particularly likely to ensue if petroleum distillates have been ingested or lavage is carried out in a patient with depressed airway protective reflexes without an endotracheal tube in situ. Liisantti et al. examined retrospectively the medical records of 257 patients with self-poisoning, and calculated an odds ratio of 2.7 (CI 0.8–9.3) for the development of aspiration pneumonitis when gastric lavage was performed in unconscious non-intubated patients. However, aspiration has been reported in alert patients even when hydrocarbons were not involved. Aspiration pneumonia has also been reported in patients who have been intubated prior to gastric lavage (18,21,44,47).
- Laryngospasm has been observed (16) particularly when a semiconscious patient has resisted the procedure, either intentionally or as a consequence of the agent ingested. Thompson et al. (27) demonstrated in a group of 42 patients that the mean (±SD) PaO_2 fell significantly ($p<0.001$) from 95 ± 13 to 80 ± 19 mm Hg during lavage. This fall was significantly greater in conscious than unconscious patients, in smokers than in nonsmokers, and was most marked in male smokers aged 45 years or older. Tension pneumothorax and charcoal empyema have also been described after lavage and the administration of charcoal via an Ewald tube (48).
- In one study of 42 patients (27), the mean (±SD) pulse rate rose significantly ($p<0.001$) from 92 ± 19 to 121 ± 23 bpm. There was a greater rise in the pulse rate in conscious than unconscious patients. Atrial and ventricular ectopic beats were also observed and transient

ST elevation developed during lavage in two patients, one of whom had a history of a previous myocardial infarction.

- Perforation of the esophagus and gut has been reported (18,19,23–26,48,49).
- Hypernatremia due to lavage with large quantities of normal saline has been described. Water intoxication has been reported (28) as a result of over-zealous lavage, particularly in children.
- Small conjunctival hemorrhages are observed commonly and are particularly likely to occur in those who are not fully cooperative with the procedure.

Appendix: Technique for Performing Gastric Lavage

- If lavage is considered appropriate, it is essential that the staff undertaking the procedure should be experienced in its execution to reassure the conscious patient and to reduce the risk of complications. Gastric lavage is not recommended outside of a health care facility.
- The procedure should be explained to the patient if conscious and not confused, and verbal consent obtained. A patient without previous experience of the procedure should be told that a tube will be passed into their stomach so that the poison can be ''washed out.''
- In case of emesis, and before undertaking lavage, it is essential to ensure that a reliable suction apparatus is available and functioning.
- Endotracheal or nasotracheal intubation should precede gastric lavage in the comatose patient without a gag reflex. An oral airway should be placed between the teeth to prevent biting of the endotracheal tube if the patient recovers consciousness or has a convulsion during the procedure.
- The patient should be placed in the left lateral/head down position (20 tilt on the table). The length of tube to be inserted is measured and marked before insertion.
- A large bore 36–40 French or 30 English gauge tube (external diameter approximately 12–13.3 mm) should be used in adults; and 24–28 French gauge (diameter 7.8–9.3 mm) tube in children. The orogastric tube should be for single-use only. The lavage tube should have a rounded end and be sufficiently firm to be passed into the stomach via the mouth, yet flexible enough not to cause any mucosal damage. The tube should be lubricated with a hydroxyethylcellulose jelly before being passed. A nasogastric tube is of insufficient bore to produce a satisfactory lavage as particulate matter including medicines will not pass; moreover, damage to the nasal mucosa may produce severe epistaxis.
- Force should not be used to pass the tube, particularly if the patient is struggling. Once passed, the position of the tube should be checked either by air insufflation, while listening over the stomach, and/or by aspiration with pH testing of the aspirate. Traditionally, an aliquot of this sample has been retained for toxicological analysis though, except in the case of forensic examinations, the majority of laboratories now prefer blood and urine for analysis.
- Lavage is carried out using small aliquots of liquid. In an adult, 200–300 mL (preferably warm 38C) fluid, such as normal saline (0.9%) or water, should be used. In a child, warm normal saline (0.9%) 10 mL/kg body weight of should be given. The volume of lavage fluid returned should approximate the amount of fluid administered. Water should be avoided in young children because of the risk of inducing hyponatremia and water intoxication. Small volumes are used to minimize the risk of gastric contents entering the duodenum during lavage, since the amount of fluid affects the rate of gastric emptying (50). Warm fluids avoid the risk of hypothermia in the very young and very old and those receiving large volumes of lavage fluid. Lavage should be continued until the recovered lavage solution is clear of particulate matter. It should be noted that a negative or poor lavage return does not rule out a significant ingestion.

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