INTRODUCTION — Gastrointestinal decontamination refers to the practice of functionally removing an ingested toxin from the gastrointestinal (GI) tract in order to decrease its absorption. Historically, many approaches have been adopted, including gastric evacuation (forced emesis or gastric lavage), intra-gastric binding (most commonly by single or multidose activated charcoal), or speeding transit of toxins to decrease total absorption time (whole bowel irrigation or cathartics). As clinical practice has evolved and understanding of the efficacy, risks, and benefits of decontamination have grown, many practices have fallen out of favor.

This topic provides an overview of the approach to gastrointestinal decontamination in poisoned adults and a review of the evidence supporting the approach described. The management of intoxication with specific agents and general management of the poisoned patient, including children, are reviewed separately. (See “General approach to drug poisoning in adults” and “Initial management of the critically ill adult with an unknown overdose” and “Approach to the child with occult toxic exposure”.)

APPROACH TO GASTROINTESTINAL DECONTAMINATION — No controlled clinical studies have demonstrated that the “routine” use of gastrointestinal (GI) decontamination reduces morbidity and mortality in poisoned patients. However, evidence from human volunteer trials and clinical studies suggest that decontamination may reduce the absorption of toxins in the GI tract and may be helpful in select circumstances [1-3].

The decision to perform GI decontamination is based upon the specific poison(s) ingested, the time from ingestion to presentation, presenting symptoms, and the predicted severity of poisoning. GI decontamination is most likely to benefit patients who:

- Present for care soon after ingestion (usually within one to two hours)
- Have ingested a poison and amount suspected to cause toxicity
- Do not have clinical factors (eg, somnolence) that make decontamination dangerous

GI decontamination should not be performed if the agent and amount ingested are clearly nontoxic, if the agent is considered fully absorbed due to delayed presentation, or if the toxin is not amenable to decontamination.

It is common practice for intentional and potentially toxic ingestions to be treated with activated charcoal (AC) alone. However, in select scenarios other methods of GI decontamination may be useful.

METHODS OF DECONTAMINATION

Activated charcoal — Activated charcoal (AC) is a highly adsorbent powder made from superheated, high surface area, porous particles produced by pyrolysis of organic material. Its extensive surface area is covered with a carbon-based network that also includes functional groups (eg, carbonyl, hydroxyl) that adsorb chemicals within minutes of contact, preventing gastrointestinal absorption and subsequent toxicity. Evidence supporting the use of AC is discussed separately.

Indications — AC is most likely to benefit patients when administered within one hour of poison ingestion, but the potential for benefit when administering later cannot be excluded [1].

Contraindications — Contraindications to the administration of a single-dose of activated charcoal (SDAC) include:

- Depressed mental status without airway protection (risk of aspiration)
Late presentation

Increased risk and severity of aspiration associated with AC use (eg, hydrocarbon ingestion)

Need for endoscopy (eg, significant caustic ingestion)

Toxins poorly adsorbed by AC (eg, metals including iron and lithium, alkali, mineral acids, alcohols) (table 1)

Presence of intestinal obstruction (absolute contraindication) or concern for decreased peristalsis (relative contraindication)

**Dose** — The optimal dose of SDAC is not known, but available data show a dose-response relationship. Studies suggest an AC:toxin ratio of 10:1 to be effective [4]. Alternatively, the following dosing regimen is suggested [1]:

- Children up to one year of age: 10 to 25 g, or 0.5 to 1.0 g/kg
- Children 1 to 12 years of age: 25 to 50 g, or 0.5 to 1.0 g/kg (maximum dose 50 g)
- Adolescents and adults: 25 to 100 g (with 50 g representing the usual adult dose)

**Administration** — AC is available as a powder that is mixed with water to form a slurry. The slurry is gritty and poorly palatable, making administration to children particularly difficult. Flavoring the slurry with juice, chocolate milk, or ice cream may improve compliance but potentially decreases the adsorptive capacity of AC [5]. AC is also commercially available as a suspension with thickening agents, such as sorbitol, which may help improve palatability and additionally act as a cathartic [6,7].

**Complications** — The overall rate of AC-associated complications reported in the literature is low [1]. Gastrointestinal side effects including fullness, abdominal pain, nausea, vomiting, constipation, and diarrhea have been reported, with higher rates occurring if AC is used in combination with sorbitol [1]. According to two randomized trials, aspiration occurs in less than one percent of poisonings and is not increased in patients who receive AC [8,9]. Aspiration occurred most often when AC was used in conjunction with gastric emptying techniques that are no longer routinely recommended.

**Evidence of efficacy and adverse effects**

**Activated charcoal: Volunteer data** — The majority of data supporting the efficacy of activated charcoal (AC) come from in vitro and animal data or volunteer trials. An early study simulating the gastric environment demonstrated that many chemicals adsorb avidly to AC in a dose dependent fashion, but that certain substances – particularly highly ionic compounds with low molecular weight, mineral acids, and strong bases – do not bind well [10]. AC has not been shown to adsorb ethanol, even when administered prior to ethanol ingestion [11].

A number of volunteer trials support the efficacy of AC when it is administered early after ingestion, with absorption decreased by up to 95 percent or more when AC is administered within five minutes [12,13]. When AC is administered one hour after toxin ingestion, systemic absorption is reduced to the range of 50 to 75 percent, depending upon the toxin [13-16]. Despite the results of these trials, it is important to remember that volunteer scenarios may differ markedly from actual poisonings with respect to the timing of presentation, amount of toxin ingested, and presence of other factors, such as food in the stomach or drugs that alter GI transit times.

The results of volunteer trials, designed specifically to evaluate the effect of AC when administered later after ingestion, are less compelling. Two volunteer trials failed to find a statistically significant reduction in absorption when AC was administered at two, three, or four hours following ingestion of therapeutic doses of acetaminophen [17,18]. A third trial demonstrated a small but statistically significant reduction in serum acetaminophen levels when AC was given three hours after drug ingestion [19]. The subjects in all three volunteer trials received therapeutic range doses of acetaminophen, so the results are difficult to extrapolate to larger ingestions that occur in poisoned patients.

**Activated charcoal: Clinical trials** — Randomized controlled trials of poisoned patients treated with activated charcoal (AC) have failed to demonstrate a consistent impact on clinically important outcomes. However, this may in part be due to methodologic problems in some studies, such as including treatments with AC given several hours after ingestion and treatment of patients with little or no risk of toxicity.

- A trial of 1479 poisoned patients randomly assigned to receive AC or no decontamination reported higher rates of...
Gastrointestinal decontamination of the poisoned patient

- A trial of 71 patients with an overdose of tricyclic antidepressants (TCA) randomly assigned patients to gastric lavage with or without AC and found no difference in serum drug concentrations between groups [21]. Of note, most patients presented late following ingestion.

- A trial of 327 patients, who were randomly assigned to receive AC or no decontamination, found no difference in length of stay, vomiting, aspiration, intubation, or mortality between groups [8]. The authors noted that benzodiazepines, acetaminophen, and selective serotonin reuptake inhibitors (SSRIs) comprised the majority of toxins, and these drugs would generally not be expected to cause severe toxicity regardless of whether GI decontamination were performed.

Two observational studies of poisoned patients examined the question of AC efficacy in late-presenting patients:

- A prospective observational series of patients with toxic acetaminophen levels who presented more than three hours following ingestion found a lower rate of liver injury among patients given AC in addition to N-acetylcysteine [22]. For patients given AC between four and eight hours after ingestion, the rate of liver injury (AST or ALT >1000 IU/L) was 0 versus 12 percent in the group that did not receive AC. Liver injury rates were also lower for those treated 9 to 12 hours after ingestion (3 versus 52 percent) and 13 to 16 hours after ingestion (10 versus 45 percent).

- A retrospective series described 981 consecutive patients poisoned with acetaminophen who were treated, prior to receiving N-acetylcysteine, with gastric lavage and AC, AC alone, or no decontamination [23]. The authors reported that, in patients presenting within 24 hours with ingestions of 10 g or greater, administration of AC prior to N-acetylcysteine resulted in a lower risk of liver injury (defined AST or ALT greater than 1000 IU/L) compared to treatment with N-acetylcysteine alone (odds ratio [OR] 0.36, 95% CI 0.23-0.58) [23]. The authors found that this effect predominates when patients present within two hours, but may extend to many who present as long as three hours later.

Activated charcoal: Adverse effects — Aspiration is the concern most often cited when clinicians choose not to administer activated charcoal (AC). In their joint position paper on single-use AC, the American Academy of Clinical Toxicology and the European Association of Poison Centres and Clinical Toxicologists state that charcoal itself is not responsible for aspiration, but rather administering it improperly (ie, to a patient with an inadequately protected airway; in association with lavage; or instilling it directly into the lung via an improperly placed nasogastric tube) [1]. In addition, when aspiration does occur, poor outcomes cannot clearly be attributed to the charcoal itself rather than the aspiration of acidic gastric contents.

Given the widespread use of AC, the overall rate of adverse effects, particularly aspiration, associated with its administration is low. In a randomized clinical trial of self-poisoned adults, AC was found to increase the risk of vomiting (23 versus 13 percent in controls) [9], but the rate of aspiration was low in both groups (two patients in each group developed aspiration pneumonia out of a total of 1479). A second trial of 327 patients found similar rates of both vomiting (14 and 15 percent, respectively) and aspiration (<1 percent in both groups) in patients treated with AC and those not treated [8]. The results of two observational studies suggest that emesis may occur at a higher rate when sorbitol is added to AC [24,25].

A retrospective chart review of 4562 overdose patients looking for predictors of aspiration found that age, male gender, GCS <15, emesis, seizure, tricyclic antidepressant overdose, and an elapsed time of more than 24 hours between ingestion and presentation were all predictors of aspiration pneumonia, whereas AC administration itself was not [26]. Another retrospective chart review of patients who received AC after intubation found that 2 out of 50, or 4 percent, developed an infiltrate not present prior to intubation [27]; however, the two cases of aspiration pneumonia could not clearly be attributed to charcoal administration.

Other less important gastrointestinal side effects have been reported. In a volunteer study, constipation and abdominal fullness occurred at a rate of 46 percent, nausea at 18 percent, and vomiting at 8 percent [19]. Constipation occurred in 60 percent of subjects in another volunteer study [13].

Multidose activated charcoal — In some instances, patients may benefit from the repeated administration of activated charcoal (MDAC). Three distinct mechanisms are thought to account for such benefit:

- Intermittent of enterohepatic recirculation

Sci-Hub
URL статьи или журнала, или DOI, или строка для поиска
Gastrointestinal decontamination of the poisoned patient

- Carbamazepine (see "Carbamazepine poisoning")
- Dapsone
- Phenobarbital
- Quinine
- Theophylline (see "Theophylline poisoning")

Volunteer and animal data suggest that MDAC increases elimination of several toxins (eg, amitriptyline, digoxin, disopyramide, nadolol, phenytoin, piroxicam, salicylates), but clinical data are currently insufficient to support the routine use of MDAC in these exposures [2].

**Contraindications** — Contraindications to the use of MDAC are similar to those of SDAC, but also include:

- Presence of intestinal obstruction (absolute) or concern for decreased peristalsis (relative)

**Dose** — An optimal dosing regimen for MDAC has not been established. In general, after the initial dose, should be administered at a rate of at least 12.5 g/hour, or the equivalent, given as divided doses. Examples of acceptable regimens include 50 g administered every four hours, or 25 g every two hours. A volunteer study found no difference in effectiveness of larger doses spread out over time compared to smaller, more frequent doses [28].

**Administration** — Administration is similar to that of AC, but the concurrent use of a cathartic, such as sorbitol is not recommended. This is of particular importance with young children, in whom the development of diarrhea may lead to dangerous fluid shifts and electrolyte imbalance [2].

**Complications** — In addition to the complications associated with single-dose AC, constipation and bowel obstruction have been reported.

**Evidence of efficacy and adverse effects** — Volunteer trials of MDAC have found significant decreases in the elimination half life of several drugs, including phenytoin, nortriptyline, aminophylline, phenobarbital, carbamazepine, phenylbutazone, digoxin, and dapsone [13,15,28-32]. However, a randomized controlled trial of 4629 poisoned patients comparing the routine use of MDAC to single-dose AC or no intervention found no difference in rates of intubation, toxin-specific clinical effects, or mortality among groups [33]. The trial was limited by the prolonged time to treatment for many patients and lower than expected mortality in the control group.

In contrast, a randomized controlled trial of 401 patients poisoned with yellow oleander-poisoned and treated with either MDAC or a single dose of AC found lower rates of mortality and ICU admission among the MDAC group [34]. This study differs from the larger trial in the narrow scope of toxin studied, shorter time to treatment, and longer administration of MDAC (along with better adherence to regimen).

The paucity of data supporting the efficacy of MDAC in actual poisonings and the availability of better treatments for some of the agents studied (eg, antibody [Fab] fragments for digoxin overdose) have informed the joint position statement of the American Academy of Clinical Toxicology and the European Association of Poison Centres and Clinical Toxicologists, which only supports the use of MDAC in life-threatening ingestions of carbamazepine, dapsone, phenobarbital, quinine, or theophylline [2].

Complications of MDAC administration are similar to those associated with single-dose AC and are described separately. (See 'Activated charcoal: Adverse effects' above.)

Additional concerns specific to the repeated administration of AC include the development of an ileus or obstruction. There are published reports of patients developing a bowel obstruction requiring surgical intervention and even bowel perforation following repeated administration of AC [35-37]. However, the large randomized trial described above did not report any such complications [33].

**Whole bowel irrigation** — Whole bowel irrigation (WBI) refers to the administration of osmotically balanced polyethylene glycol electrolyte solution (PEG-ES) to induce liquid stool and mechanically flush pills, tablets, or drug packets from the GI tract.

**Indications** — WBI is not routinely recommended, but it may be helpful in the following settings [38]:

- Potentially toxic ingestions of sustained-release or enteric coated pill formulations

Dose — There are no dose-response studies for WBI, but a consensus recommendation regarding dosing is as follows [3]:

- Children 9 months to 6 years: 500 mL/hr
- Children 6 to 12 years: 1000 mL/hr
- Adolescents and adults: 1500 to 2000 mL/hr

WBI is continued until the rectal effluent is clear. Radiographic studies may be useful in some circumstances (eg, iron ingestion, body packing) to confirm the absence of residual toxin.

Administration — Most patients tolerate poorly the large volume of fluid that must be taken orally to effectively perform WBI. In many cases, nasogastric tube placement is necessary for PEG-ES administration.

Complications — There is a paucity of published data regarding complications associated with WBI. GI complaints including nausea, vomiting, cramping, and bloating are relatively common [3, 38]. Patients with vomiting and an unprotected airway are at risk of aspiration, but this has not been reported as a direct result of WBI.

Evidence of efficacy and adverse effects — Whole bowel irrigation (WBI) may be useful for patients who have ingested extended-release or enteric-coated tablets, particularly when patients present more than two hours after ingestion and therefore are not likely to benefit from charcoal administration. Volunteer data suggest that WBI is effective in some cases, but may interfere with activated charcoal (AC) when administered concurrently [14].

One volunteer study examining the effect of WBI on extended release acetaminophen absorption as well as the transit time of radiopaque markers found that WBI did not significantly reduce systemic drug absorption but did lead to a clustering of markers in the right hemicolon in the majority of test subjects [39]. The significance of the latter finding remains unclear.

One retrospective cohort study of acute-on-chronic lithium exposures found that early decontamination with sodium polystyrene and WBI was associated with lower Poison Severity Scores (PSS) (odds ratio [OR] 0.21; 0.04-0.99), but was underpowered to detect a difference in PSS with WBI alone [40].

There is a dearth of high quality evidence supporting the use of WBI, with case series comprising the majority of studies [3, 38]. In one study, statistical analysis of blood concentrations of 71 patients poisoned with extended-release venlafaxine found that WBI, when administered with AC, reduced the total absorbed fraction of drug by 29 percent [41].

Gastric lavage — Gastric lavage (GL) refers to the passage of a large bore orogastric tube followed by repetitive instillation and aspiration of small aliquots of fluid in an attempt to aspirate pill fragments or other toxins from within the stomach. Referred to as “stomach pumping” by the lay public, this formerly widespread modality has been largely abandoned due to unclear benefit (particularly when compared with other readily available and less invasive techniques) and the risk of serious complications.

Indications — The American Association of Poison Centers (AAPC) and the European Association of Poisons Centres and Clinical Toxicologists (EAPCCT) have issued a joint statement that gastric lavage should not be employed routinely, if ever, in the management of poisoned patients [42]. However, there are rare cases (eg, recent and potentially lethal ingestion) where the procedure may be considered after carefully weighing the well-documented risks against the unclear benefits.

Contraindications — GL is contraindicated in the following cases:

- Unprotected airway
- Caustic ingestion (due to risk of exacerbating any esophageal or gastric injury)
- Hydrocarbon ingestion (due to high aspiration risk)
- Patients at risk of GI hemorrhage or perforation (recent surgery, underlying anatomic abnormality or pathology)
Evidence of efficacy and adverse effects — Gastric lavage (GL), once a mainstay of emergency decontamination of poisoned patients, has been largely abandoned due to the effectiveness of activated charcoal (AC). The results of multiple studies call into question the effectiveness of GL:

- A randomized trial of self-poisoned patients reported that 52 percent of radio opaque tablets the patients had been asked to swallow immediately prior to GL were retained in the GI tract, while 33 percent were propelled forward into the small bowel [43].
- In a study of poisoned patients, endoscopy performed immediately following gastric emptying revealed 17 patients treated with GL (88 percent) had residual intragastric solid [44].
- A volunteer study found that only 45 percent of ingested cobalt was recovered using GL [45].

When compared directly to AC or when used in conjunction with AC, GL generally does not provide added benefit according to the results of volunteer and clinical trials. Representative studies include the following:

- In a randomized controlled trial of 808 poisoned patients, symptomatic patients treated with gastric emptying (either ipecac or gastric lavage) had a fourfold increase in intubation rates and a two-fold increase in the rate of ICU admission compared to those receiving AC [20]. GL was associated with a significantly increased risk of aspiration pneumonia.
- An observational study of 981 consecutive patients poisoned with acetaminophen compared outcomes among those treated with AC, AC plus GL, or no decontamination, in addition to N-acetylcysteine, and found no additional benefit from GL beyond that provided by AC alone [23].
- In a volunteer study comparing GL administered with AC versus administration of AC alone, no statistically significant differences in reduction of systemic absorption of acetaminophen were noted between the two groups [46].

These results notwithstanding, there is evidence that a small subset of patients presenting early (within one hour of ingestion) may benefit from GL. In a randomized controlled trial comparing gastric emptying techniques (syrup of ipecac and GL) with AC, no significant differences were found between groups with respect to clinical deterioration or admission. However, subgroup analysis revealed that patients presenting within one hour of ingestion and treated with GL had a higher rate of clinical improvement than those receiving AC [47]. A second trial using the same protocol produced similar results, but the group treated with gastric emptying included more severe overdoses and when the authors controlled for this difference GL appeared to be of less benefit [48].

Gastric lavage carries significant risks, which, given its questionable clinical benefit, usually outweigh arguments in favor of its use. In a randomized trial, patients treated with GL had higher rates of aspiration (9 versus 0 percent) and intubation compared to controls receiving AC [20]. These findings are consistent with numerous published case reports [42]. Esophageal and gastric perforation represents another, albeit less common, risk of GL [42,47].

Endoscopy/surgery — Endoscopic or surgical removal of poisons may be indicated when a life-threatening toxin has been ingested and cannot be effectively removed by less invasive means. Examples include lethal amounts of heavy metals or pharmacobezoars refractory to whole bowel irrigation. Surgical removal is indicated in patients exhibiting toxicity following ingestion of large cocaine packets (“body packers”). In most cases, endoscopy is not recommended for the removal of illicit drug packets due to the risk of packet rupture during extraction attempts [49]. (See “Internal concealment of drugs of abuse (body packing)”.)

Outdated treatments — The following modalities of GI decontamination have been used in the past but are no longer routinely recommended:

- **Syrup of Ipecac** — Previously a mainstay of prehospital and emergency department management of toxic ingestions, Syrup of Ipecac (SoI)-facilitated gastric emptying is no longer recommended by the American Academy of Clinical Toxicology (AACT), the European Association of Poisons Centres and Clinical Toxicologists (EAPCCT), or the American Association of Pediatrics (AAP) [50,51]. A review of volunteer and clinical studies suggests that SoI is less
Cathartics — Cathartics (eg, magnesium citrate, magnesium sulfate, sorbitol, mannitol) are intended to decrease poison absorption by enhancing rectal evacuation of toxins or the poison-AC complex. The AACT and EAPCCT advise against the use of cathartics as single agent therapy, and the combination of cathartic and AC (eg, AC and sorbitol) should be used sparingly, if at all, and limited to a single dose [56]. (See 'Activated charcoal' above.)

Adverse effects associated with cathartic use include increased abdominal pain, nausea, vomiting, excessive diarrhea, dehydration, and electrolyte abnormalities.

Dilution — Dilution was historically recommended following the ingestion of acidic or alkaline corrosives to decrease the concentration and, thus, the tissue damage from the ingestion. This approach is problematic and we recommend that it not be performed.


SUMMARY AND RECOMMENDATIONS — The vast majority of adults with toxic ingestions have an uncomplicated course and recover fully with supportive care. The use of techniques to reduce absorption of poisons by gastrointestinal (GI) decontamination must be guided by the potential severity of the poisoning, the time from ingestion, and the potential risk to the patient of the interventions considered. In addition, the availability of an effective antidote substantially reduces the importance of decontamination.

While various decontamination procedures can reduce blood concentrations of some ingested poisons, there are few data demonstrating that use of these procedures reduces morbidity or mortality. Given these considerations, we suggest the following guidelines for decontamination:

- A protected airway (ie, patient is alert with intact airway reflexes or is intubated) is essential prior to initiation of any GI decontamination procedure.
- Patients may benefit from the administration of activated charcoal (AC) in a single dose of 1 g/kg (maximum dose 50 g), particularly if given within one to two hours of ingestion.
- AC should be withheld in situations where clinical benefit is not expected, including:
  - Nontoxic ingestions
  - Patients who present when poison absorption is considered complete
  - Poisons not bound by AC (table 1)
  - Patients whose risk of complications (eg, aspiration) is unacceptably high
- A cathartic (eg, 1 g/kg of 70 percent sorbitol) may be administered with the initial dose of AC. Cathartics should not be used as monotherapy, and repeated doses are not recommended.
- Whole bowel irrigation is reserved for patients who have ingested toxic foreign bodies (eg, drug packets), sustained release or enteric-coated drugs, or toxic materials not bound by AC (eg, heavy metals).
- Gastric lavage is not recommended for routine decontamination. Rarely, gastric lavage may be helpful if the patient has ingested a toxic amount of a poison and the procedure can be performed within one hour of ingestion. When performed, gastric lavage should be followed by AC administration, unless the agent ingested is not adsorbed by AC.

Use of UpToDate is subject to the Subscription and License Agreement.

REFERENCES


### Agents for which activated charcoal is not recommended

<table>
<thead>
<tr>
<th>Category</th>
<th>Agents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heavy metals</strong></td>
<td>Arsenic, Lead, Mercury, Iron, Zinc, Cadmium</td>
</tr>
<tr>
<td><strong>Inorganic ions</strong></td>
<td>Lithium, Sodium, Calcium, Potassium, Magnesium, Fluoride, Iodide</td>
</tr>
<tr>
<td><strong>Boric acid</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Corrosives</strong></td>
<td>Acids, Alkali</td>
</tr>
<tr>
<td><strong>Hydrocarbons</strong></td>
<td>Alkanes, Alkenes, Alkyl halides, Aromatic hydrocarbons</td>
</tr>
<tr>
<td><strong>Alcohols</strong></td>
<td>Acetone, Ethanol, Ethylene glycol, Isopropanol, Methanol</td>
</tr>
<tr>
<td><strong>Essential oils</strong></td>
<td></td>
</tr>
</tbody>
</table>

Graphic 77553 Version 2.0
Contributor Disclosures


Contributor disclosures are reviewed for conflicts of interest by the editorial group. When found, these are addressed by vetting through a multi-level review process, and through requirements for references to be provided to support the content. Appropriately referenced content is required of all authors and must conform to UpToDate standards of evidence.

Conflict of interest policy