The Poisoned Patient in the Emergency Department: An Update on Management

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Introduction

The management of the poisoned patient has evolved from the induction of vomiting through gastric lavage to activated charcoal. As we learn about how medications and poisonings affect the human body, we also recognize that methods of decontamination can potentially affect clinical outcomes in the toxicologic patient. Decontamination may potentially cause adverse effects on our patients. The emergency physician often makes the decision to begin therapy and decontamination for the acutely poisoned patient with or without the assistance of poison control centers.

In part one of two in the series of articles; we will discuss activated charcoal, multidose activated charcoal, syrup of ipecac, cathartics and gastric lavage. In part two of the series we will review whole bowel irrigation, forced diuresis and urine alkalization.

Gastrointestinal Decontamination

The concept behind GI decontamination is to adsorb, "flush," or eliminate the offending agent from the body before it can cause serious toxicity. Timing is an important factor since the amount of time the substance spends in the gastrointestinal tract can be absorbed. Efficacy in the acutely poisoned patients has not been adequately documented. The potential risk of the intervention must be a serious consideration before action takes place.

Syrup of Ipecac

Syrup of ipecac is made from the dried rhinzome and roots of the *cephalis acuminate* or *cephalis ipecacuanha* plant.[1] Two forms of ipecac are available: ipecac syrup and ipecac fluid extract. Ipecac fluid extract is approximately 14 times more potent than the syrup. We will use "ipecac" to refer to the syrup of ipecac form. Ipecac has been used for many years to remove toxic substances post ingestion. In fact up until 2003 it was advocated by the American Academy of Pediatrics (AAP) to keep ipecac in the medicine cabinet for pediatric exposures.[2] Since then the AAP has discouraged this practice. Ipecac is primarily used for pediatric ingestion and not for adult exposures. In addition the use of ipecac is generally used in the home environment to induce vomiting. This use of ipecac was thought to decrease the number of pediatric visits to the emergency department. Currently the AACT and EAPCCT position statement does not support routine use of ipecac in the poisoned patient.[1]

Ipecac induces vomiting through two substances, emetine (methylcephaeline) and cephaeline. These alkaloids work both in the gastric mucosal receptors and the chemoreceptor trigger zone in the brain to cause vomiting. Onset of action is 15 to 30 minutes after ingestion. Duration of action may be up to 60 minutes.[1]

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Indications

There have been no studies that have shown induction of vomiting through the use of ipecac in a certain time frame has been beneficial. Dosing of ipecac has been suggested in the *Table 1*.

Adverse Reactions

If ipecac is given to the obtunded or the unconscious patient, the risk of aspiration is high. Hydrocarbon ingestions, highly corrosive substances, volatile oils, the elderly, and other medical conditions all may worsen through the induction of emesis by ipecac. Care must be exercised in patients with cardiac conditions since ipecac contains cardiotoxin that may cause CHF, tachycardia, atrial fibrillation, depressed myocardial contractility, myocarditis, and hypotension. This cardiotoxin is emetine which can cause dysrhymias, QTc prolongation, ventricular dysfunction, cardiomyopathy, and tricuspid or mitral valve insufficiency.[3-5] Reversible skeletal myopathy may also occur to cause myalgias, weakness, hypotonia and elevations in creatine kinase. Most cardiac complications have been seen in bulimia patients who use ipecac chronically.

Complications

Prolonged vomiting, dehydration, complications are due to the risks of vomiting, diarrhea, lethargy.

Evidence for Use

Recommendations for the use of ipecac were at one time widely recommended by *poison control centers*, toxicologists, and pediatricians especially for pediatric toxic ingestions. It was regarded as safe to administer with a low side effect profile. This was changed due to the increasing numbers of persons with eating disorders using ipecac. Ipecac induced cardiomyopathy is seen in this population.[3-5] This abuse has caused the over-the-counter medication to be removed from store shelves in the U.S.

Induction of vomiting may seem to be an intuitive treatment for those individuals who ingest toxic amounts of substances. Studies have compared the efficacy of ipecac versus other decontamination modalities. In volunteer studies ipecac was less effective than giving charcoal. Even patients who received gastric lavage in trials seemed to have less absorption. In fact since the onset of action ipecac is between five

Table 1. *Summary table.*

	Dosing	Indications	Contraindications and Cautions
Syrup of Ipecac	<6 months: physician supervision 6-12 months: 5-10 mL followed by 120-240 mL of water 12 months-12 years: 15 mL followed by 120-240 mL of water >12 years: 15-30 mL followed by 240 mL of water may repeat if emesis does not occur within 30 minutes of administration	Not recommended	Decreased mental status, may cause persistent vomiting
Activated Charcoal	<1 year: 10–25 g or 0.5–1.0 g/kg 12 months to 12 years: 25–50 g or 0.5–1.0 g/kg >12 years: 25 to 100 g	Ingestions presenting in <1 hour	Not Recommended in hydrocarbon, metal (Lithium, Iron, etc.), acids, alkali, pesticide ingestions. Do not give to patients with decreased mental status unless airway is protected.
Multiple Dose Activated Charcoal	First dose as indicated above with sorbitol. Subsequent doses are without sorbitol	Use in life-threatening ingestions of carbamazepine, dapsone, phenobarbital, quinine, or theophylline	Do not use if the patient has signs and symptoms of decreased gut motility
Gastric Lavage		Generally not recommended in most cases Rare Exceptions: podofylin, colchicines, other life-threatening ingestions and those without antidotes especially those not adsorbed by activated charcoal	Increased risk of aspiration and esophageal perforation

and 15 minutes, the ingested substance may be absorbed or advanced beyond the pylorus prior to emesis. Furthermore ipecac may incompletely remove ingested tablets.

Position statements regarding the use of ipecac have all discouraged the use of ipecac in pediatric toxin ingestions. We currently do not recommend ever using it.

Activated Charcoal

Activated charcoal (AC) was found to be efficacious in poisonings when Professor Touery ingested a deadly dose of strychnine before the French Academy of Medicine in 1831. After the ingestion he took activated charcoal to adsorb the deadly substance and survived.[6]

Activated charcoal is obtained from carbon materials such as wood, coal, coconut shells by adding acid and steam to those substances. This creates pure carbon that is made into a very fine powder. The conversion into a very fine powder allows for the adsorption of the toxin to take place due to its extremely large surface area. The surface area ranges from 1.000-2.000 m^2/gram.[7]

Activated charcoal does not adsorb pesticides, hydrocarbons, acids and alkalis, iron, lithium, solvents, arsenic, boric acid, bromide, potassium and fluoride well. AC works best on low water soluble and non-dissociated salts. However due to the uncertainty of what toxic substances a patient ingests, AC should be considered in most cases.

Dosing of AC is largely based on a dose response relationship. Some authors advocate a 10X gram for gram dosing. Several animal studies provided the basis for this dosing.[8-10] These studies compared the amount of AC given to animals in various ratios to see what impact this would have on the absorption of the medication. The amount of activated charcoal may be impractical based on the milligram dose ingested verses the amount of activated charcoal the patient must have in order for this adsorption to take place. In addition a patient with a polypharmaceutical ingestion of varying amounts of medication would make dosing cumbersome. One can assume the larger dose of activated charcoal the better. Moreover weight based dosing is a convenient way to dose the patient with the adsorbent.

Activated charcoal with and without sorbitol is available. This may be a concern when using multiple dose activated charcoal, which will be discussed later. Sorbitol is hyperosmotic causing a catharsis action on the bowels.

Contraindications

Again those with unprotected airways and substances with high aspiration potential are at risk for aspiration pneumonia and pneumonitis. At risk are patients those who have esophageal pathology or recent surgery and a history of gastrointestinal perforation. Although not a contraindication, administration of activated charcoal in a patient who may need endoscopy will obscure the view of the endoscopist increasing the risk of potential complications and hampering the intended results of this valuable procedure. Relative contraindications include small bowel obstruction/perforation, ileus, substances that do not adsorb to activated charcoal (hydrocarbons, metals, etc.).

Complications

Aspiration pneumonia is one of most feared complication in the use of activated charcoal. Aspiration leads to mediastinitis and prolonged resolution of illness. Bowel obstruction has been reported, in particular with multiple dosing.

What's the Evidence?

Is activated charcoal just as effective as other forms of decontamination? The evidence suggests if it is given within one hour of ingestion, it is.[1] Human volunteer studies of using varying medications and amounts of AC showed a mean reduction in serum levels ranging from 47.3 to 51.7% at 30 minutes, 38.14 to 40.07% after 60 minutes, and 16.5 to 34.54% 120 minutes postingestion.[11] The studies were performed in healthy volunteers with varying doses of AC and non-toxic ingestions of medications. In addition the pharmacokinetics of the medication at therapeutic dosing versus ingestion at toxic doses is probably inaccurate. But based on this data, it appears that giving AC as early as possible postingestion has the most benefit.

Animal studies confirmed in vitro reductions of medications compared to control groups where no intervention was given.[12] Overall these studies provide some insight into the effectiveness of AC but their conclusions should be carefully extrapolated to humans.

Finally studies in poison patients have shown there was no change in clinical outcomes in patients that receive AC versus other decontamination modalities such as syrup of ipecac and gastric lavage or no treatment.[13-24] The study conclusions are complicated by study design flaws such as patient self reported ingestions and the absence of serum drug levels.

Studies to evaluate the efficacy of activated charcoal are limited. The studies are poorly designed. Most have shown no change in clinical outcome. Based on volunteer studies activated charcoal may decrease absorption if given within one hour post ingestion. Administration beyond one hour has not been validated but theoretically it may be helpful in substances with delayed absorption such as extended release preparations.

Multiple Dose Activated Charcoal (MDAC)

Multiple dose activated charcoal (MDAC) may be indicated in those with life-threatening ingestions of carbamazepine, dapsone, phenobarbital, quinine, or theophylline.[25] Increased effectiveness is possible with medications that undergo enterohepatic circulation such as phenobarbital. Sorbitol is a cathartic which speeds the transit time of the activated charcoal through the gut. Sorbitol can cause dehydration since its osmotic action can pull water from the gut lumen. Additionally sorbitol may lead to electrolyte imbalance.[26]

MDAC has mixed results in reducing the serum levels of carbamazepine, cardiac glycosides, salicylates, and phenytoin.[27-30] Efficacy in overdose is unproven due to the limited number of randomized trials. Lastly there is no good evidence MDAC prevents morbidity and mortality in toxicity.

Gastric Lavage

Gastric lavage has largely fallen out of favor due to several reasons. Several studies have shown the efficacy of performing this previously routine measure has not resulted in improved outcomes. In fact the risks of complications are high. These risks include hypoxia, esophageal perforation, bleeding, dysrhythmias, aspiration pneumonia, etc. Bradydysrhythmias can occur using this technique secondary to vagus nerve stimulation. There is a possibility of advancing the toxin further into the gastrointestinal tract. The tube itself is a limiting factor since pill fragments may not be removed due to the hole and lumen diameter. Assembly of a seldom used apparatus may extend well beyond the one hour time frame.

Technique

Orogastric lavage is performed by inserting a large bore tube through the mouth or nose into the stomach. Once the tube is placed, the contents of the stomach are lavaged to remove potentially toxic substances. Small volumes of liquid are introduced into the stomach via the tube and subsequently removed by aspiration. Using a standard nasogastric tube is low yield and potentially harmful due to its small lumen size and irrigation has the potential to advance the toxin further into the gastrointestinal tract.

Contraindications

Several contraindications for gastric lavage are of note. The patient with an unprotected airway, those with decreased level of consciousness, and those at risk for significant bleeding, patient's with an increased risk of esophageal perforation and finally those who ingested substances that may increase the complications of aspiration pneumonia (hydrocarbons).

Indications

There are some cases where gastric lavage should be considered. The ingestions include patients that present to the emergency department within a short time (less than one hour of ingestion) and in life threatening substances such as colchicines, etc. The risks and benefits of performing this somewhat dangerous technique should be highly considered. In most cases giving the patient activated charcoal may outweigh the risk of adverse events associated with gastric lavage. In general we do not recommend gastric lavage in the great majority of cases. If gastric lavage is performed, we recommend orotracheal intubation prior to lavage as an adjunctive airway protection measure.

Conclusions

In general, the toxic patient may benefit from interventions when they present to the emergency department. As with any therapy we must weigh the risks and benefits for the patient. For the obtunded patient or the patient at risk to become obtunded later, care must be exercised to avoid therapies that may cause further harm such as aspiration pneumonia. Indeed considering the type of substance ingested must be made early in order to avoid such complications.

Since the field of toxicology is always changing, we can only recommend activated charcoal within one hour of ingestion. Otherwise, supportive care and consideration for other interventions can be made with the assistance of your regional poison center or local toxicologist.

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DÜZELTME / ERRATUM

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