ELSEVIER

CLINICAL Pediatric Emergency Medicine

To Decontaminate or Not to Decontaminate? The Balance Between Potential Risks and Foreseeable Benefits

Benoit Bailey, MD, MSc, FRCPC

The various techniques that can be used to achieve gastrointestinal decontamination have been reviewed in position statements sponsored by the American Academy of Clinical Toxicology and the European Association of Poison Centres and Clinical Toxicologists. Although the indications have been presented, clinicians still have some latitude as to whether they should use them or not in a particular case. The aim of this article is to present an approach that clinicians may use to help them decide to decontaminate a patient or not after an oral exposure. After a review of the position statements, we will discuss how the risk assessment of the exposure can be made and suggest an approach, the gastrointestinal triangle, to balance the potential risks against the foreseeable benefits of decontamination.

Historically, decontamination has been pivotal in the management of the poisoned patient. By decontaminating a patient, our goal is to reduce the absorption of the toxin and thus prevent or at least decrease the manifestations of the exposure. Decontamination can include surface decontamination of the skin and the eyes after dermal and ophthalmologic exposure, respectively, and gastrointestinal decontamination after ingestion of a substance. This article will focus on the decision process involved in gastrointestinal decontamination.

Gastrointestinal decontamination includes techniques to evacuate the stomach such as syrup of ipecac-induced emesis and gastric lavage; techniques to prevent absorption such as activated charcoal, whole bowel irrigation (WBI), and cathartics. All these techniques have specific indications, contraindications, and adverse effects that have been presented in detail in position statements sponsored by the American Academy of Clinical Toxicology (AACT) and the European Association of Poison Centres and Clinical Toxicologists (EAPCCT) [1-5]. These are available on the web (http://www.clintox.org/Pos_Statements/Intro.html; accessed December 27, 2007). As multiple doses of activated charcoal are an intervention intended to enhance elimination of previously absorbed poisons, it will not be discussed in this review.

The aim of this article was to present an approach that clinicians may use to help them decide whether to decontaminate a patient or not after an oral exposure. For that, we will discuss how the risk assessment of the exposure can be made and suggest an approach, the gastrointestinal triangle, to balance the potential risks against the foreseeable benefits of the decontamination. To fully understand the choices, we will first present the indications, contraindications, and adverse effects of the techniques presented in the AACT and EAPCCT position statements.

Position Statements on Gastrointestinal Decontamination

Gastric Evacuation

Ipecac Syrup

It is stated in the AACT/EAPCCT position statement [1] that "There are insufficient data to support or exclude ipecac

Divisions of Emergency Medicine and of Clinical Pharmacology and Toxicology, Department of Pediatrics, CHU Sainte-Justine, Montreal, QC, Canada.

Reprint requests and correspondence: Benoit Bailey, MD, MSc, FRCPC, Department of Pediatrics, CHU Sainte-Justine, 3175 Chemin de la Côte-Ste-Catherine, Montreal, QC, Canada H3T 1C5. (E-mail: benoit.bailey@umontreal.ca)

1522-8401/$ - see front matter © 2008 Elsevier Inc. All rights reserved.
doi:10.1016/j.cpem.2007.11.001

administration soon after poison ingestion. Ipecac should be considered only in an alert conscious patient who has ingested a potentially toxic amount of a poison. As the effect of ipecac diminishes with time and as clinical studies have demonstrated no benefit from its use, it should be considered within 60 minutes of the ingestion. Even then clinical benefit has not been confirmed. Contraindications include compromised airway protective reflexes (including coma and convulsions), ingestion of a substance that might compromise airway protective reflexes or anticipate the need for advanced life support within 60 minutes, ingestion of hydrocarbons with high aspiration potential, ingestion of a corrosive substance, such as an alkali or strong acid, or debilitated, elderly patients or medical conditions that may be further compromised by the induction of emesis." The adverse effects of ipecac are summarized in Table 1.

Gastric Lavage

It is stated in the position statement [2] that "Based on experimental and clinical studies, gastric lavage should not be performed, if ever. In certain cases where the procedure is of attractive theoretical benefit (eg, recent ingestion of a very toxic substance), the substantial risks should be weighted carefully against the sparse evidence that the procedure is of any benefit. Contraindications include 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 an alkali or strong acid, ingestion of hydrocarbons with high aspiration potential, and patients who are at risk of hemorrhage or gastrointestinal perforation due to pathology, recent surgery, or other medical conditions such as a coagulopathy." The adverse effects of gastric lavage are summarized in Table 1.

Table 1 Summary of the adverse effects of the various gastrointestinal decontamination techniques [1-5].

Technique	Adverse effect
Ipecac	Diarrhea Lethary/drowsiness Prolonged (>1 h) vomiting
Gastric lavage	Aspiration pneumonia Esophageal or gastric perforation Laryngospasm, and hypoxia and cardiac dysrhythmias Fluid and electrolyte imbalance
Single-dose activated charcoal	Complication of aspiration or the direct administration of charcoal into the lung Emesis Corneal abrasions upon direct ocular contact
Whole bowel irrigation	Nausea and vomiting Pulmonary aspiration
Cathartics	
Single dose	Nausea, abdominal cramps, vomiting, transient hypotension
Multiple doses	Dehydration, hypernatremia or hypermagnesemia depending on cathartic used

Prevention of Absorption

Single-Dose Activated Charcoal

It is stated in the position statement [3] that "Based on volunteer studies, activated charcoal is more likely to produce benefit if administered within 1 hour of poison ingestion. The administration of activated charcoal may be considered if a patient has ingested a potentially toxic amount of a poison up to 1 hour after ingestion. Although volunteer studies demonstrate that the reduction of drug absorption decreases to values of questionable clinical importance when activated charcoal is administered at times greater than 1 hour, the potential for benefit after 1 hour cannot be excluded. Activated charcoal is contraindicated if the patient has an unprotected airway, such as in a patient with a depressed state of consciousness without endotracheal intubation. Activated charcoal is also contraindicated if its use increases the risk and severity of aspiration (eg, a hydrocarbon with high aspiration potential). Patients who are at risk of hemorrhage or gastrointestinal perforation due to pathology, recent surgery, or medical conditions could be further compromised by single-dose activated charcoal. The presence of activated charcoal in the gastrointestinal tract may obscure endoscopic visualization, but a corrosive is not an absolute contraindication when charcoal is used for co-ingested agents that are systemic toxins." The adverse effects of single-dose activated charcoal are summarized in Table 1.

Whole Bowel Irrigation

It is stated in the position statement [4] that "whole bowel irrigation should not be used routinely, but could have potential value in a limited number of toxic ingestions, based on experimental studies and anecdotal reports. Whole bowel irrigation should be considered for potentially toxic ingestions of sustained-release or enteric-coated drugs. Whole bowel irrigation should be considered in the management of patients who have ingested substantial amounts of iron because of the high morbidity and mortality of this poisoning and a lack of other options for gastrointestinal decontamination. Whole bowel irrigation should be considered for the removal of ingested packets of illicit drugs. Contraindications to whole bowel irrigation include bowel perforation, bowel obstruction, clinically significant gastrointestinal hemorrhage, ileus, unprotected or compromised airway, hemodynamic instability, and uncontrollable intractable vomiting." The adverse effects of whole bowel irrigation are summarized in Table 1.

Cathartics

It is stated in the position statement [5] that "Based on available data, there are no definite indications for the use of cathartics in the management of the poisoned patient. Contraindications include absent bowel sounds, recent abdominal trauma, recent bowel surgery, intestinal obstruction, or intestinal perforation, ingestion of a corrosive substance, volume depletion, hypotension, or significant electrolyte imbalance. Magnesium cathartics should not be given to patients with renal failure, renal insufficiency, or heart block. Cathartics should be administered cautiously to the very young (< 1 year of age) and to the very old." The adverse effects cathartics are summarized in Table 1.

Use of the Position Statements

The position statements have been systematically developed and are excellent reviews of the available evidence on gastrointestinal decontamination [1-5]. Clinicians are encouraged to read, at least once, the summary statements because they provide excellent background information. However, because of the absence of evidence of clear benefit and also because of the numerous combinations of possible clinical situations, the indications for the use of the various techniques remain uncertain in some instances and offer clinicians some latitude in using them or not. Therefore, a decision process still needs to be undertaken by clinicians and the position statements are only guides in that decision.

Decontamination Decision-Making Process

Risk Assessment

A risk assessment of the poisoning should be completed soon after the patient presents to the emergency department, and once initial resuscitation has occurred. Risk assessment has been described as a distinct cognitive process through which the clinician attempts to predict the likely clinical course and potential complications for the individual patient at that particular presentation [6]. The clinician also needs to initiate supportive care and monitoring of the patient. In addition, one also needs to weigh the potential risks against the foreseeable benefits of the management specific to poisoned patients, such as the use of techniques to prevent absorption or to enhance elimination, and antidotes. Risk assessment includes evaluation of the substance and dose ingested; the time that has elapsed since ingestion; current clinical status; and individual patient factors [6]. This is almost never straightforward as every clinical situation is unique. As the clinician attempts to predict the prognosis of the patient with the available information, their experience and knowledge will be important factors in the decision-making process.

Gastrointestinal decontamination should only be performed if the patient has ingested a toxic amount of a substance. For any substance there is a toxic dose that may or may not be known. Given the circumstances of the ingestion, the history of the substance(s) and the dose ingested may not always be completely accurate. In children, the factors limiting the accuracy of an exposure history usually depend on the age of the patient (with the exception of cases of Munchausen by proxy). In toddlers, the history is usually assumed to be accurate but limited by the unwitnessed ingestion (unintentional exposure). Either the patients show symptoms or signs of toxicity compatible with the exposure because the ingestion did indeed occur or the patients remain asymptomatic because they have not ingested the suspected substance or the dose was not sufficient to cause toxicity. It is virtually impossible to determine in advance what the situation will be; the circumstances in which the child was found are usually of no help in predicting the outcome. It is usually customary to assume the worst possible scenario given the time since ingestion and the substance(s) involved. If the patient does not show any symptoms or signs of toxicity by the time expected, given the suspected ingestion, then it is likely that this worst possible scenario does not apply. Exposures that result in death or those with major effects (life-threatening or significant residual disability or disfigurement) remain the exception: 0.007% and 0.2% of the 1,563,652 exposures in children reported to American poison centers in 2005, respectively [7]. For some substances, quantitative measurements can help to determine whether the ingestion has occurred and in some cases may help in the prognosis. However, this remains the exception as most substances cannot be measured easily.

The other pediatric age group most often involved in poisoning is adolescents. Adolescents most often have intentional exposure. In these cases, history is relatively accurate as the ingestion is most often a cry for help, an impulsive gesture [8,9]. However, if the history does not correspond to the clinical status of the patient, then the risk assessment should be revised. This is true at all ages because risk assessment is a dynamic process [6]. In adolescents, the primary limiting factor in the history is usually the presence of an altered mental status. In that situation, it is important to seek relevant information from family members or the first responders as to what substances were available to the adolescent. Worst case scenario will then usually apply with the caveat previously mentioned.

To determine whether an ingestion is toxic, the clinician has also to consider the time since ingestion, the symptoms and signs of toxicity at initial presentation, and the patient's particular characteristics. Based on that, one can usually determine whether the exposure is toxic or not. This represents the first step toward determining what monitoring and treatment are

required for the patient before medical discharge can be considered.

Gastrointestinal Decontamination Triangle

Once the clinician has determined that an ingestion is toxic, based on the risk assessment, they must then decide whether gastrointestinal decontamination needs to be performed. For that, the potential risks must be balanced against the foreseeable benefits (Figure 1). This needs to be done simultaneously, in parallel, and not in sequence [10]. There is no point in taking any risk for some small theoretical benefit such as in the case of a patient with a benzodiazepine overdose that is drowsy on presentation to the ED and for which supportive management is sufficient in the majority of cases. However, in the same case but for which there was a tricyclic antidepressant coingestion, there might be more benefits than possible risks if the delay between ingestion and assessment in the emergency department is short. Decontamination should never be done routinely; there must be justification to perform it. So, as with any other intervention in medicine, it must be based on a thorough assessment of the risk/benefit ratio to meet "Primum non nocere."

To evaluate whether there are potential benefits we must consider several factors (Figure 1). Is the technique we are considering useful? For example, activated charcoal does not significantly absorb alcohols, corrosives such as alkalis and strong acids, and metals such as iron and lithium. Delay between ingestion and presentation is crucial, as clearly presented in the position statements, and determines for the most part whether benefit is likely. For most techniques, in theory, the sooner they are performed, the more likely they will have a chance of reducing absorption and have an impact on the prognosis. The dilemma is that there cannot be a time limit applicable to all clinical situations. This is particularly so in patients who have ingested modified release pharmaceuticals. The decision to decontaminate may be influenced if there is an antidote for the poison; it makes more sense to decontaminate if the substance has no known antidote compared to a substance with an antidote. Furthermore, if the patient has already developed toxicity, not only is there an increased risk of the intervention, but the goal of preventing toxicity cannot be achieved because the substance has already entered the circulation and reached tissues [11]. Thus, the purpose for the decontamination needs to be clearly determined. If we are doing it to prevent something already present it does not make sense in most situations [11]. If we are doing it to prevent something that has not yet occurred and is still possible given the information we have, then decontamination may indeed make sense.

Individual patient's characteristics and the situation must also be considered. We may feel that the insertion of a nasogastric tube in an uncooperative patient or in a toddler is not warranted considering the theoretical benefits; or if the patient is going to be transferred to another center, there might be a delay or interruption in the administration of the decontamination technique that could result in decreased efficacy.

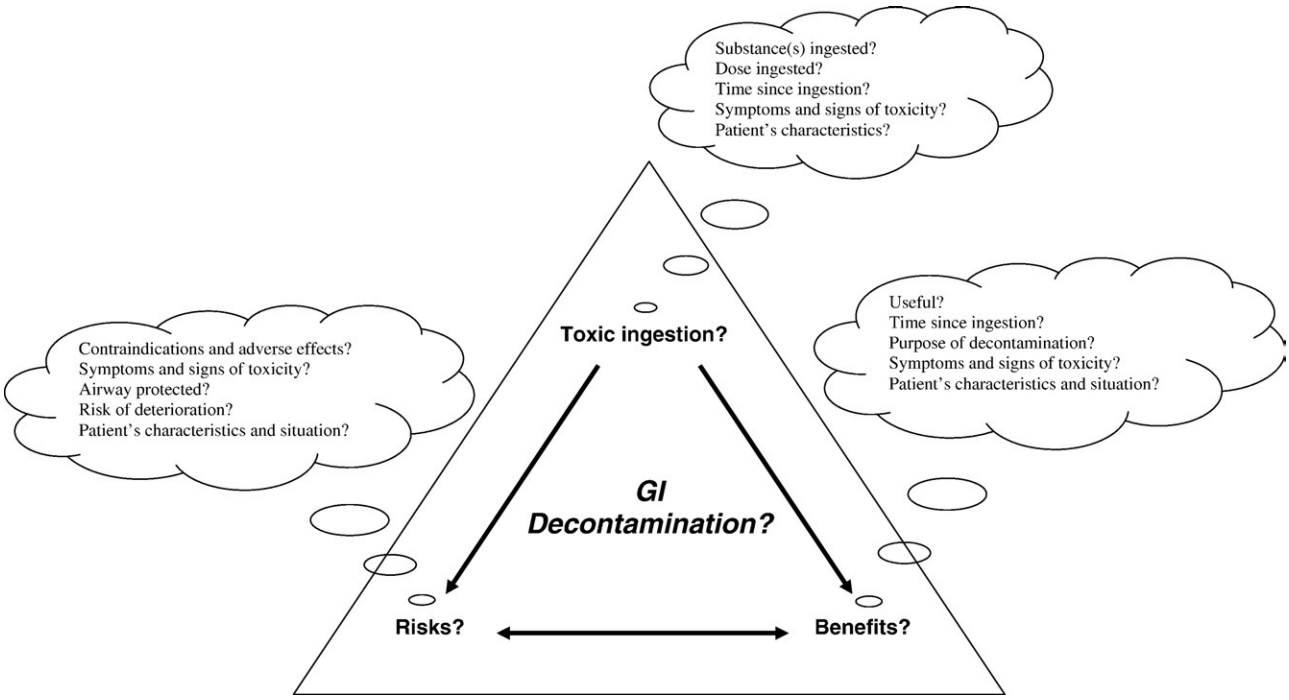

Figure 1 Gastrointestinal triangle to help determine the need for gastrointestinal decontamination [10]. Data used with permission from Bailey B (*Clin Toxicol*. 2005;43:59-60).

To assess the potential risks involved in using a particular decontamination technique (Figure 1), one must not only know its contraindications and be aware of its adverse effects, but also determine whether the patient's airway is protected at the time the decontamination is done or thereafter. Thus, not only current symptoms and signs of toxicity need to be considered, potential deterioration of the patient must also be considered in the decision-making process. If the patient is likely to require intubation to protect the airway in the near future, then either the patient should not be decontaminated or he/she should be intubated before this is done. There is no doubt that it is preferable for a patient to be intubated in an intensive care unit for altered mental status for less than 24 hours, because no activated charcoal has been given, versus requiring intubation for aspiration pneumonia for several days because charcoal was administered. This does not mean that all patients should be routinely intubated before decontamination is done when there is a potential risk of deterioration. Again, risk/benefit ratio of intubation should be carefully assessed in the decision-making process; the likelihood of the patient needing intubation solely because of their clinical condition instead of just for decontamination purposes must be considered. Finally, the patient's characteristics and the situation should also be taken into account for this step.

Which Decontamination Techniques to Use?

At the same time we are evaluating whether a patient needs to be decontaminated, we must determine which technique to use. Considering the points made in the position statements, gastric emptying should be performed on rare occasions. In the emergency department, this implies using gastric lavage on very rare occasion (by example within minutes of an ingestion of a very toxic substance not well adsorbed by charcoal such as cyanide or mercuric chloride); there is virtually no place for the use of ipecac syrup in that setting [1]. It is important to mention for the clinician keen on performing gastric lavage that the use of any gastric emptying delays the administration of activated charcoal, the technique most likely to reduce absorption. In most circumstances, the strategy of using only activated charcoal is more effective than the strategy of using gastric emptying followed by activated charcoal even when the ingestion occurred within 30 to 60 minutes of presentation.

To prevent absorption, single-dose activated charcoal may be used in most patients. For some specific ingestions, such as large ingestions (because there appears to be a dose-response relationship [3]), activated charcoal may also be repeated one time or more. One can also argue that more than 1 dose may be useful for ingestion of substances that delay gastric emptying (opiates and anticholinergics) or if there is evidence from blood levels that there is still some ongoing absorption. Whole bowel irrigation may be done on occasion. Its most important indication in children is for iron poisoning. Ingestions of sustained-release or enteric-coated drugs is another indication for whole bowel irrigation [4]. Cathartics should not be used at all [5].

Application of the Gastrointestinal Decontamination Triangle

Case 1

A 16-year-old adolescent girl is suspected of having ingested the remaining content of her mother's prescription: 28 venlafaxine XR 75 mg and 28 zaleplon 5 mg approximately 45 minutes ago. Her vital signs are normal, the Glasgow Coma Scale (GCS) is 15, and her speech is slow but she is not drowsy at the moment. The electrocardiogram (ECG) is normal.

Should Decontamination Be Performed?

Considering the amount of venlafaxine taken, the ingestion should be considered toxic because of the risk of a prolonged QRS interval, hypotension, and seizures. The amount of zaleplon should also be considered toxic; it is likely responsible for the patient's slow speech. However, taken alone we would not worry because of the low intrinsic toxicity associated with this drug. Because it has been only 45 minutes since the ingestion, the patient's clinical status is compatible with the history. The foreseeable important benefit would be the prevention of the cardiotoxicity and the seizures. We could also prevent some of the decrease in level of consciousness associated with venlafaxine XR (as it is a sustained-release drug). However, because we are at 45 minutes postingestion, it is likely that we will see some decreased level of consciousness secondary to the zaleplon ingested. The principal potential risk would be to have the patient lose her airway protection early (decreased level of consciousness or seizures), therefore increasing the risk of aspiration. Given that we are 45 minutes postingestion, it is unlikely that seizures will occur early (venlafaxine is a sustained-release drug). Altered level of consciousness could be a problem but is unlikely to be associated with a loss of airway protection on its own (because of the low intrinsic toxicity of zaleplon). Thus, it appears that there are more benefits than risks for our patient; therefore decontamination should be performed.

Which Technique?

Gastric emptying should not be performed (recent ingestion but not very toxic substances). A dose of activated charcoal can certainly be given at this time. Whole bowel irrigation could be considered; however, it

may be difficult to perform because of the expected altered level of consciousness. There is no indication for the use of cathartics, either alone or in combination with charcoal [5].

Case 2

A 2-year-old was found 20 minutes ago playing with tablets of diltiazem CD 240 mg. The grandmother is not sure how many pills were left in the bottle or at what time the child could have taken it. At this time, the child has no symptoms. Vital signs are normal, the GCS is 15, and the ECG is normal.

Should Decontamination Be Performed?

Given that 1 diltiazem could produce toxicity in this age group, we can consider this to be a toxic exposure. The foreseeable benefit is unclear because we do not know the time of ingestion. Benefit is present if it is less than 1 to 2 hours since ingestion. However, if the ingestion occurred more than 4 to 5 hours ago, the benefit is likely to be small considering the child is still asymptomatic. The risk of decontamination is minimal given the child is asymptomatic. Thus, the benefit could be important if the child has indeed taken any with minimal or no risk present; therefore decontamination should be performed.

Which Technique to Use?

Gastric emptying should not be performed (timing of ingestion unknown and toxic substance possibly ingested but well adsorbed by charcoal). A dose of activated charcoal can certainly be given at this time. Whole bowel irrigation could be considered as the diltiazem is in a sustained release form; however, because of the time aspect discussed previously, this could also be omitted if the history favors a very long delay between ingestion and presentation. There is no indication for the use of cathartics, either alone or in combination with charcoal [5].

Case 3

A 15-year-old boy is found unconsciousness in his room the morning after an argument with his parents. He had been out drinking the night before. His medical record shows that he has previous visits for ingestion of alcohol and benzodiazepines. On arrival to the ED, his blood pressure is 120/75 mm Hg, heart rate is 90 per minute, respiratory rate is 12 per minute, and temperature is 36.0°C. Oxygen saturation is 96% on 100% O_2. He is intubated because of a GCS of 6. The ECG is completely normal. The QRS interval is 80 milliseconds. Medications that were available at home include acetaminophen, ibuprofen, diazepam, lorazepam, and amitryptiline. He also had access to some beer, vodka, and whisky. An initial blood gas shows a pH of 7.29, pCO_2 of 58, and bicarbonate of 22.

Should Decontamination Be Performed?

We do not know what was taken and in what quantities. Acetaminophen and ethanol serum concentrations are pending. Given that the patient's level of consciousness is decreased, we can conclude that the ingestion was toxic (if other causes of coma are excluded because of the context and the physical examination—however, if there is any doubt of trauma, a computed tomography scan of his head should be performed). Considering that the patient already has signs of toxicity and the time of ingestion is unknown, it is likely that the benefit of gastrointestinal decontamination is minimal for most substances. The only problem with that assumption is that the patient could have taken a tricyclic antidepressant (can cause seizures and cardiotoxicity). However, because these symptoms usually occur within the first 6 hours after ingestion and that the adolescent was last seen awake more than 8 hours ago, in the absence of manifestations of tricyclic antidepressants poisoning at this time (no prolongation of the QRS or other ECG change including no tachycardia), we can argue that the risks of cardiotoxicity or seizures are minimal. The risk of aspiration is also minimal considering that the patient is intubated. However, aspiration could still occur. Although the risks are not high, the foreseeable benefit appears minimal for this patient, thus decontamination should not be done.

Summary

Position statements of the AACT and EAPCCT have been systematically developed and are excellent reviews of the available evidence on gastrointestinal decontamination. Because of the limited evidence supporting these position statements, the indications of the various decontamination techniques are not clear for many clinical situations. Clinicians must decide for each case of poisoning whether decontamination should be performed. With the help of the gastrointestinal triangle, this decision should be made based on the risk assessment of the poisoning and the foreseeable benefits and potential risks of the decontamination procedure.

References

1. American Academy of Clinical Toxicology, European Association of Poisons Centres and Clinical Toxicologists. Position paper: ipecac syrup. Clin Toxicol 2004;42:133-43.
2. American Academy of Clinical Toxicology, European Association of Poisons Centres and Clinical Toxicologists. Position paper: gastric lavage. Clin Toxicol 2004;42:933-43.
3. American Academy of Clinical Toxicology, European Association of Poisons Centres and Clinical Toxicologists. Position paper: single-dose activated charcoal. Clin Toxicol 2005;43:61-87.
4. American Academy of Clinical Toxicology, European Association of Poisons Centres and Clinical Toxicologists. Position paper: whole bowel irrigation. Clin Toxicol 2004;42:843-54.
5. American Academy of Clinical Toxicology, European Association of Poisons Centres and Clinical Toxicologists. Position statement: cathartics. Clin Toxicol 2004;42:243-53.

6. Daly F, Little M, Murray L. Risk assessment based approach to the management of acute poisoning. Emerg Med J 2006;23:396-9.
7. Lai M, Klein-Shwartz W, Rodgers G, et al. 2005 Annual report of the American Association of Poison Control Centers' national poisoning and exposure database. Clin Toxicol 2006;44:803-932.
8. Tournier M, Molimard M, Abouelfath A, et al. Accuracy of self-report and toxicological assays to detect substance misuse disorders in parasuicide patients. Acta Psychiatr Scand 2003;108:410-8.
9. Pohjola-Sintonen S, Kivisto K, Vuori E, et al. Identification of drugs ingested in acute poisoning: correlation of patient history with drug analyses. Ther Drug Monitor 2000;22: 749-52.
10. Bailey B. Gastrointestinal triangle. Clin Toxicol 2005;43:59-60.
11. Tenenbein M. Gastrointestinal decontamination of the overdose patient in the year 2000. Clin Pediatr Emerg Med 2000;1: 195-9.