A retrospective review of whole bowel irrigation in pediatric patients

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Background. Traditionally whole bowel irrigation (WBI) has been advocated for ingestions involving substances not bound with activated charcoal as well as extended release and enteric coated medications. Other than isolated case reports, little exists in the literature regarding the use of WBI in poisoned pediatric patients. The purpose of this study is to better understand the use of WBI in pediatric patients.

Method. A retrospective chart review of California Poison Control System electronic database for human poisoning cases between the years 2000 and 2010 was performed. Results. A total of 176 cases were identified. The most common age of poisoned patients that received WBI was 2 years. There were more pediatric patients who received WBI between 2000 and 2005 then between 2006 and 2010. The top three substances in which WBI was used were calcium channel blockers, iron, and antidepressants. There were 72 cases involving sustained release and delayed release substances. The top five sustained release/delayed release substances were nifedipine, bupropion, verapamil, diltiazem, and felodipine. Adverse drug reactions were noted in 17 patients, vomiting in 16 patients and abdominal pain in one patient. In 36 cases, abdominal radiographs were performed. Sixteen were positive, and in four cases, repeat abdominal radiographs demonstrated a decrease in opacities. Twelve patients had documented pills in their effluent.

Conclusion. Transient adverse drug reactions, vomiting and abdominal pain, were associated with WBI. Polyethylene glycol plus electrolyte lavage solution (PEG–ELS) was more frequently administered through the nasogastric tube. Patients who underwent WBI through nasogastric tube received higher doses of PEG–ELS.

Keywords Gut and hepatotoxicity; Other; GI
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Fig. 1. Number of patients treated with WBI between age 0 and 12 (See colour version of this figure in the online version www.informahealthcare/ctx).

calcium channel blockers \( n = 57 \) (32.4%), concentrated iron-containing preparations \( n = 44 \) (25%), and antidepressants \( n = 21 \) (11.9%). For all cases, there were 72 involving sustained (SR) or extended release (ER) substances. The top five SR/ER substances were nifedipine \( n = 20 \), bupropion \( n = 14 \), verapamil \( n = 9 \), diltiazem \( n = 8 \), and felodipine \( n = 5 \). The number of estimated pills ingested ranged from 1 to 207. All exposures in the 159 patients between the ages of 8 and 12. The mean time of WBI initiation from the time of ingestion was \( 6.2 \pm 7.6 \) hours (range 2–74 hours). The initial dose of PEG–ELS was identified in 69 cases and ranged from 20 ml/h to 1000 ml/h with a mean (± SD) of 307.3 ± 200.4 ml. Fourteen of the 69 patients received greater than 500 ml/h PEG–ELS. The mean age of the 14 patients who received greater than 500 ml/h WBI was \( 3.6 \pm 3.6 \) years (range 1–12 years). The total dose of PEG–ELS was identified in 14 cases and ranged from 20 to 2000 ml with a mean (± SD) of 1424.3 ± 1553.5 ml. WBI was administered through a nasogastric tube (NG) in 86 patients, oral in 16 patients, and unspecified in 74 patients. The mean dose per route of PEG–ELS was \( 332 \pm 175.1 \) ml/h (range 100–1000 ml/h) in patients with the NG route and \( 172.5 \pm 108.1 \) ml/h (range 40–300 ml/h) in patients with the oral route.

Reported exposure outcomes per AAPCC criteria demonstrated that 90 patients had no effects, 31 patients had minor effects, 24 patients had moderate effects, 9 patients had major effects, and 12 patients were not followed to a final outcome. No deaths were reported. Of the 57 calcium channel blocker exposures, none had major effects, 3 had moderate effects, 8 had minor effects, 42 had no effects, and 4 had unknown effects. Of the 44 iron exposures, 2 had major effects, 2 had moderate effects, 14 had minor effects, 21 had no effects, and 5 had unknown effects. Of the 21 antidepressant exposures, 3 had major effects, 3 had moderate effects, 1 had minor effects, and 14 had no effects.

An ADR was noted in 17 patients, vomiting in 16 patients, and abdominal pain in one patient. In 36 cases, abdominal radiographs were performed. Sixteen cases demonstrated radio-opaque pills images on the abdominal radiograph. In four cases, abdominal radiographs were repeated and demonstrated a decrease in opacities. The number of patients with documented pills in their effluent was 12 (6.8%). Five of these patients have documentation regarding the initial dose of PEG–ELS, which ranges from 100 to 450 ml/h PEG–ELS. Six of these 12 patients also received single dose activated charcoal. Nine of the 12 patients were admitted to the hospital. There were three 1-year old patients, eight 2-year old, and one 4-year old patient. Four patients ingested iron, two patients ingested lead, one patient ingested antiepileptic medication, two patients ingested antihypertensive medications, and two patients ingested antidepressants.

Discussion

Poison centers recommend the use of WBI for potentially dangerous pediatric ingestions. The California Poison Center’s indications for WBI are large ingestion of xenobiotics poorly adsorbed by activated charcoal, large ingestion of sustained-release or enteric coated drugs, and ingestion of foreign bodies or drug-filled packets or condoms. In our study, 157 of 176 patients (89.2%) received WBI after PCC recommendations. The remaining 19 patients either had no documentation of PCC recommending WBI or the treating physician initiated WBI prior to consulting the PCC. Whole bowel irrigation entails using polyethylene glycol 3350 added to a balanced electrolyte lavage solution (PEG–ELS). WBI has been adopted to accelerate the elimination of substances
poorly bound to activated charcoal as well as extended release and enteric coated medications. WBI has been used in the management of iron, lead, and sustained-release medications. Our study revealed that the calcium channel blocker, iron, antidepressants including SSRIs and atypical antidepressants were the top three substance classes where WBI was used.

Multiple studies of WBI utilization for preoperative bowel preparation have demonstrated tolerability. Isotonic PEG–ELS solution does not shift fluid or electrolytes and can be continued for days without major morbidity. Kaz crozowski et al. reported a 33-month-old male who received 44.3 l of PEG–ELS over 5 days without adverse effect resulted from the large volume or long duration of administration.

The position statement on WBI by The American Academy of Clinical Toxicologists and The European Association of Poisons Centres and Clinical Toxicologists in 2004 stated that WBI is contraindicated in patients with ileus, bowel obstruction, perforation, and in patients with hemodynamic instability or compromised unprotected airways. In addition, “WBI should be used cautiously in debilitated patients or in patients with medical conditions that may be further compromised by its use.” Cumpton et al. reported two adult patients who overdosed on sustained release calcium channel blocker. Both hemodynamically unstable patients received WBI and had adverse reactions. One patient had persistent emesis and developed abdominal distension during the WBI procedure. The second patient suffered from aspiration pneumonitis. Givens et al. reported a pediatric patient with bupropion poisoning who received WBI. The patient had a displacement of the NG tube in the oropharynx associated with abdominal distension and PEG–ELS fluid accumulation. The author suggested using WBI only in patients who can protect their airway.

Adverse effects resulting from the use of WBI include vomiting, abdominal bloating, fullness, cramping, flatulence, and aspiration. Lee et al. reported using WBI in 45 children undergoing colonoscopy or colorectal surgery. ADRs were reported in 17 children, including nausea/vomiting in 12 cases, abdominal colic in two cases and distending discomfort in three cases. Not surprisingly, the most commonly reported adverse effect in our pediatric patient population was vomiting. Although ADRs occurred in 10% of patients, they were limited to transient gastrointestinal symptoms. ADR was recorded when vomiting or abdominal pain was reported to the PCC. Vomiting and abdominal pain may be the result of poisoning rather than an ADR to treatment. Furthermore, vomiting may be due to a NG tube placement or large volume of PEG. We do not know the definitive cause of vomiting and abdominal pain. Thus the number of ADR may be lower than 10%.

The recommended dosing of WBI is 0.5 l/h or 25 ml/kg/h for pediatric patients, or 500 ml/h for children 9 months to 6 years, 1000 ml/h for children 6–12 years, and 1500 to 2000 ml/h for adolescents. In this study, the initial dosing of WBI and the total dosing of WBI varied through a wide range. The initial dose ranges between 20 and 1000 ml/h. The total dose was 20–2000 ml. The 2-year-old girl who was given 20 ml PEG–ELS was likely a failed attempt at WBI as the PCC recommended 500 ml/h or 35 mg/kg/h. The patients who received PEG orally overall received less volume than those who received it through NG. We conclude from our data that NG was the preferred route of administration by clinicians, and that clinicians were more comfortable managing WBI through an NG. We noted 12 patients with documented pills in their rectal effluent, which may be a marker of efficacy with respect to WBI therapy. Clear rectal effluent was not documented in other cases. The number of pediatric patients with pills in their rectal effluent may be higher than 6.8%. The substances included iron, lead, antihypertensive medications, antiepileptic medications, and antidepressants. Of the 102 patients with a known dose of PEG–ELS administration, the majority of patients received PEG solution through NG. Fourteen of the 102 patients received 500 ml/h or greater.

Limiting factors with respect to total dose administration may be related to NG discomfort, or distaste of PEG–ELS solution.

Study limitation

The retrospective study provided limited data. Efficacy of this treatment modality in pediatric patients could not be measured. Reports of adverse reactions were based on patient/clinician reporting. Therefore, if the patients did not report adverse effects to their clinician or the clinician failed to report them to the poison center, they were not recorded. The poison center data were obtained by telephone, thus relying on voluntary reporting. The number of pills ingested cannot be verified. The noncompliance rate in following PCC recommendation, that is, the data regarding the patients who actually received WBI versus those that refused or had aborted attempts was not available. Furthermore, the effective dose for WBI in poisoned pediatric patients can not be extrapolated from the data. Our search criteria only included cases in which WBI was performed due to the subjective and variable nature of poison specialist coding, especially when pooling data from multiple poison centers. We are unable to obtain matching data for the CCB, iron, and antidepressant groups of patients who did not receive WBI. We also could not report how many times WBI was recommended by the poison center and not performed. Finally, the distribution of the ages is unusual because of “rounding” by the parent/caller or SPI. The large number of 2-year old patients is likely due to rounding.

Conclusion

The frequency of reported usage of WBI seems to be declining. Most patients received PEG–ELS through NG. Patients who underwent WBI through NG received higher doses of PEG–ELS. WBI seems to be used more appropriately in patients who received PEG–ELS through NG. Clear effluent was not documented in any case. Although ADRs occurred in 10% of patients, they were limited to transient gastrointestinal symptoms such as vomiting and abdominal pain. Additional studies are required to determine the
relative efficacy and preferred treatment regimen for WBI in pediatric patients.

Declaration of interest
The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

References