Evaluation of Administration of Activated Charcoal in the Home

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ABSTRACT. *Objective.* **Activated charcoal (AC) is recognized as the treatment of choice for gastrointestinal decontamination after many ingestions. AC use in the home has been limited by concerns that parents would not administer it properly and that children would refuse to take AC. Previous descriptions of home administration have reported mixed results.**

Methods. **This was an 18-month consecutive case series of all patients for whom AC administration was recommended in the home. Data collected included AC availability in the home and/or a local pharmacy, success in administration, amount administered, time after ingestion to AC administration, difficulties in administration, adverse effects, age and gender of patient, substance involved in poisoning, and medical outcome. All cases were followed for at least 3 days after the ingestion. Patients who initially had home AC recommendation but who ultimately were treated in the emergency department (ED) served as a comparison group.**

Results. **Home administration of AC was recommended in 138 cases. A total of 115 individuals (83%) were treated with AC in the home, with no failures to administer AC. Reasons for failure to manage at home were 1) mother preferred ED (8 cases), 2) could not locate AC (7 cases), 3) pharmacy closed for the night (6 cases) and 4) no home telephone for follow-up (2 cases). Time to AC administration after ingestion was a mean of 38 minutes (±18.3) for home treatment and 73 minutes (±18.1) for ED treatment. Ninety-five percent of home cases received AC in ≤60 minutes versus 33% for ED management. AC was in the home in 11 cases at the time of recommendation. The amount of AC administered was a mean of 12.1 g (standard deviation: 6.9) and a median of 12 g. Eight children (6.9%) who were treated at home vomited after AC versus 3 (13%) who received ED treatment. No aspirations or complications occurred.**

Conclusion. **AC can be administered successfully by the lay public in the home. Home use of AC significantly reduces the time to AC administration.** ***Pediatrics*** **2001; 108(6). URL: http://www.pediatrics.org/cgi/content/full/108/6/e100;** ***activated charcoal, home treatment, children.***

ABBREVIATIONS. AC, activated charcoal; GI, gastrointestinal; ED, emergency department.

Activated charcoal (AC) is recognized as the treatment of choice for gastrointestinal (GI) decontamination after many ingestions.[1,2] Recognition of AC's superior efficacy over syrup of ipecac has led to suggestions of administration of AC in the home.[3–5] However, use in the home has not gained wide acceptance because of concern that it would not be administered properly by the untrained lay public and that many children would refuse to take AC. This concern has generated considerable speculation but little evidence that AC utility in the home is limited by these problems. Previous descriptions of home administration reported mixed results.[6,7]

In 1996, the Kentucky Regional Poison Center began to advise parents of small children to stock AC in the home for use in the event of an unintentional poisoning. Simultaneously, pharmacies throughout the state were encouraged to stock AC. Previous unpublished experience by the poison center had suggested that parents could safely administer AC in the home with proper guidance. A protocol was established for appropriate situations in which to recommend AC use in the home. We report an 18-month experience with AC use in the home.

METHODS

This was a prospective, consecutive-sample poison center case series over 18 months. Entrance criteria included all cases in which AC was recommended to be used in the home. Appropriate cases for home AC use were identified by toxin-specific protocols. The protocol for home use of AC stated that a 15-g container was recommended and that the parents should be advised to administer the entire contents. In cases in which the parent did not have AC in the home, the nurse at the poison center called local pharmacies to locate AC and then referred the parent to the pharmacy that stocked AC. In this way, the parent avoided wasting time driving around to locate AC and at the same time the local pharmacy was alerted by the poison center to watch for that parent. If AC could not be located at 1 of 3 local pharmacies that the caller identified as being within 10 to 15 minutes of the residence, then AC was considered unavailable and the patient was referred to the emergency department (ED) for AC administration. The decision of whether to use AC at home was made within 10 minutes of the original call. All cases were followed up by telephone for at least 3 days. Telephone follow-up of all patients who were treated at home occurred at 30 minutes to 1 hour after initial call, 4 hours after initial call, and during the morning of the next 3 days. If complications occurred, then the poison center medical director was to be contacted for direction. All cases in which AC was recommended for use in the home were evaluated for the following data elements: age, gender, toxic substance, availability of AC in the home, pharmacy availability of AC, final patient treatment location, time between ingestion and completion of administration of AC, amount of AC administered, difficulties in administration, occurrence of vomiting or diarrhea, evidence of aspiration, charcoal stool, and medical outcome. The amount of AC administered was based on parent assessment of the amount of AC that remained in the container. Patients for whom AC was recommended but was not available formed a comparison group. These patients were referred to a health care facility for AC. To compare groups, we used χ^2 with the Yates correction factor and Student *t* test where appropriate. This study was approved by the University of Louisville Human Studies Committee.

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TABLE 1. Patient/AC Administration Data

Parameter	Home AC Use (115 Patients)	HCF AC Use (23 Patients)
Mean age (y; SD)	3.0 (2.1)	2.5 (2.4)
Median age (y)	2.0	2.5
Age range (y)	1–14	1–9
Mean time beginning AC administration (min; SD)	38 (18.3)	73 (18.1)*
Range of time (min)	2–90	45–120
Patients with AC administration begun ≤60 min	95%	33%*
Failure to administer adequate AC dose	0%	0%
AC present in home	11	0
AC in local pharmacy	104	0

HCF indicates health care facility.
* $P < .05$.

RESULTS

During the 18 months of the study, home administration of AC was recommended in 138 cases, of which 115 were able to be treated at home and 23 went on to be treated in the ED. A comparison of patients who were treated at home and patients who were treated in the ED is presented in Table 1. Substances involved in the home-treated cases are listed in Table 2. Reasons for failure to treat at home were 1) mother preferred to take child to ED ($n = 8$; 6.9%), 2) unable to locate AC ($n = 7$; 6.0%), 3) pharmacy closed for the night ($n = 6$; 5.2%), and 4) no home telephone for follow-up ($n = 2$; 1.7%).

The amount of AC administered in the home-treated patients was a mean of 12.1 g (standard deviation: 6.9) and a median of 12 g (Fig 1). Fifty-six patients (47%) consumed the entire container of AC, which included 46 15-g containers, 8 25-g containers, and 2 30-g containers. Eight (7%) of 116 children who were treated at home vomited after AC administration. In contrast, 3 (13%) of 23 children who were given AC in the ED vomited ($P > .05$). No aspirations or complications were reported in the home-treated cases. The caregiver in 30 cases that were treated at home (25.9%) expressed some sort of difficulty, although all were able to administer the AC successfully. Table 3 shows the reported problems.

DISCUSSION

Numerous studies have evaluated the efficacy of AC versus ipecac and have shown AC to be a superior method of GI decontamination.[3–5,7–9] Since this work has been done, there has been a continuous 10-year decline in the use of ipecac while at the same time a comparable increase in the use of AC.[10] This has followed a similar decline in the general use of home GI decontamination. Although AC has supplanted ipecac in the ED setting, ipecac has continued to remain the primary method of GI decontamination in the home setting. The hesitation to move AC into the home setting has been based primarily on the unsupported concern that parents could not administer AC in the home effectively. In addition, there has been some concern that with the decline in use of home GI decontamination, a new therapy may not be necessary. The 2 studies that examined the use of AC in the home found conflicting results. Grbcich et al[6] evaluated home use of AC in the Boston area by having a nurse from the poison center go to the house to observe the parents administer the AC. They concluded that parents were unable to administer the full dose of AC. However, this study is limited by its small size ($n = 6$) and the bias introduced by an outsider's coming to a parent's house to observe his or her ability to administer an experimental antidote at a time when most ingestions were still treated with ipecac.[10] In our study, the parents were advised that their child should receive AC and the choice was given to them to administer it at home or take the child to the ED for AC administration. In either case, the parents were advised that their child should receive AC. The results from our study indicate that when given proper instruction, parents can effectively give AC in the home setting. Lamminpaa et al[7] found similar results in the only other large prospective study on this subject. In that Finnish study, 102 patients were administered AC at home during the 3-month study period.[7] The study involved cases called to the Finnish Poison Information Center. The AC was most often administered with yogurt, crushed fruit, water, milk, or ice cream. Although the overall mean ingested dose in the study was 7.9 g, higher mean doses were taken when the AC was given with water versus dairy products (12.2 g vs 7.3 g). In all but 5 cases in the Finnish study, there was success in administering AC at home.

A primary issue with AC administration is the time between the ingestion of the toxin and the administration of AC. Volunteer studies suggest that AC is more likely to reduce poison absorption if it is administered within 1 hour of ingestion.[2,11] In our study, patients at home consistently received AC in

TABLE 2. Substances Ingested in Cases Treated With AC at Home

Substance	*n*
Mushrooms	98
Cough/cold prep	6
Acetaminophen	2
Buspiron	1
Cigarette butts	1
Fluoxetine	1
Paroxetine	1
Guanfacine	1
Metoclopramide	1
Mole bean	1
Promethazine	1
Tramadol	1
Vitamin (no iron)	1

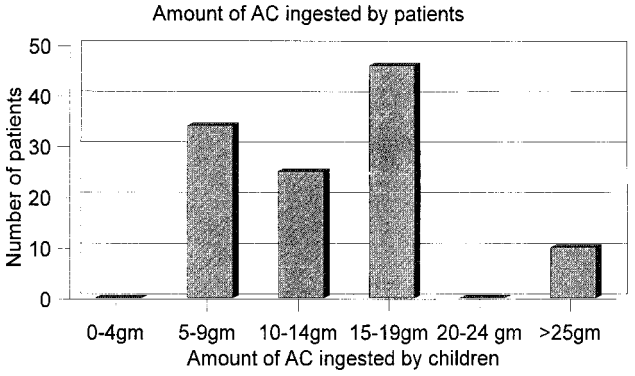

Fig 1. The number of patients in each category by dose of charcoal administered.

TABLE 3. Difficulties Reported by Caregivers During Administration of AC at Home (n = 30)

Difficulty	n*	% of Total
Did not like taste	21	18
Vomited	8	6.9
Made a mess	3	3.4
Constipated	1	0.9
Nausea	1	0.9
Too much volume	1	0.9

* Total of reports is greater than patient number because several patients experienced more than 1 difficulty.

less than 1 hour after ingestion. Lamminpaa et al reported similar success in early administration in the Finnish study. In contrast to this early administration, the majority of our patients who were referred to the ED for AC administration did not receive AC within the first hour after ingestion. Lamminpaa et al[7] in the Finnish study found a similar delay in AC administration in their patients who were referred to the ED. Similar results concerning the time of administration were reported in 2 studies of AC administration in patients who were transported to the ED.[12,13] Wax et al[12] reported a median time of 82 minutes to AC administration in the ED, whereas Crockett et al[13] found a mean time of 51.4 minutes. The time to administration of AC in both of these studies is from time of paramedic contact with the patient until AC administration in the ED and not, as in our study, time of ingestion until AC administration. Administration of AC at home has the potential to reduce the time between toxin ingestion and AC administration and therefore to increase the efficacy of AC. In appropriate circumstances, rapid, safe administration may allow for prudent treatment of a number of patients who might have previously been treated in the ED. In addition to more rapid administration of AC, home use of AC produced a considerable health care dollar savings by reducing the number of patients who would have previously required treatment in an ED. For example, in our patient group, the 98 patients who had ingested mushrooms would have previously been referred to the ED for AC administration and were now able to be treated outside the hospital.

The optimum dose of AC to administer is not known.[2,14] Dosing regimens have been based on age (25–50 g in children), on weight (1 g/kg), and on the estimate of the toxin ingested (10 g of AC per 1 g of toxin).[14] Recommendations have been for administration of the largest dose that the patient is able to handle when the dose of the toxin is unknown or when the dose of the toxin is known for a ratio of 8:1 or 10:1.[14] When considering use of AC in the home, the dose of toxin ingested is small by the nature of the decision to treat at home. Larger doses or unknown but potentially larger doses would be referred to the ED for treatment. It was concluded, therefore, that the use of the 10:1 ratio for dosing would be sufficient. We then compared this ratio with doses of toxins treated at home. An example of the calculations for this process is with over-the-counter decongestants. The dose recommended at home by our poison center was ≤15 mg/kg, producing an ingested dose in a 15-kg child of ≤300 mg. A 10:1 ratio for this dose required >3 g of AC. Similar calculations were done for other expected products. For mushrooms, amanitin content is estimated at <5 mg/g mushroom. Four ounces of mushroom (a large ingestion for a child) would provide <20 mg of amanitin toxin. Two grams of AC would provide a 100:1 ratio. Therefore, it was believed that a 15-g dose of AC would be recommended and a 5-g dose would be the minimal dose considered sufficient for successful administration.

In this study, only a small portion of parents (10%) had stocked AC in the home before the need to administer it occurred. This may be partially explained by the fact that this is a new recommendation and the message to stock AC may not have gotten to all parents of small children. However, even with syrup of ipecac, for which the message has been delivered consistently for many years, there remains difficulty in getting parents to store ipecac in the home.[15] Greater efforts need to be put into educating parents about the need to stock AC in the home in advance of a poisoning. In addition, education efforts need to be directed at pharmacists and physicians. In advance of our recommendation to parents, the poison center spent 6 months contacting each pharmacist, pediatrician, and family practice physician in the state by letter concerning our planned use of AC in the home. A follow-up study was performed to assess whether AC was available in the community pharmacies.[16] In this study, 203 randomly selected pharmacies, chosen from all regions of the state, were surveyed by telephone. Seventy-two percent had AC on the shelf at the time of the call, and an additional 9% stated that it was normally part of their stock but that they were out of it that day. Because of the high percentage of parents who may not stock either AC or ipecac at home, this emphasis on professional education needs to be included in any effort to put AC in the home.

The most common difficulty encountered (18%) was the child's dislike of the taste of AC. In most cases, this was alleviated by alternating the AC with sips of juice. A second solution is to mix the AC with soda or juice before administration. One product (Charcoal Aid-G, Requa, Inc, Bridgeport, CT) comes in a granulated form with instructions to mix with

soda. This seems to help with palatability. Lamminpaa et al[7] had success mixing AC with a number of substances such as ice cream, yogurt, crushed fruit, and juice. Despite this difficulty, in no case did palatability prevent home administration of AC. In several cases, caregivers who had previously administered syrup of ipecac at home stated that they preferred AC because of the lack of persistent vomiting and associated mess.

The majority of the patients who were treated at home with AC in this study were mushroom ingestions. However, use of AC at home has many potential uses and wide potential applicability.

Absolute contraindications to AC administration are an unprotected airway, a GI tract not anatomically intact, and when AC may increase the risk and severity of aspiration (eg, hydrocarbons with a high aspiration risk).[2] To this list may be added suggested contraindications of substances that are not absorbed to AC (eg, alcohols, iron, lithium) and after ingestion of a caustic substance.[7,17]

Serious complications of AC administration in the hospital setting are rare but include aspiration of the AC and AC containing empyema.[18] In our case series of AC administration in the home, no patient reported respiratory difficulty or other evidence of aspiration after 72 hours via telephone follow-up. Although it is clear that no therapy is completely without risk, examination of the published reports of AC aspiration in the hospital setting reveals a number of contributing factors that are not likely to be part of any case that is treated at home with AC. In all but 1 of the published cases, the AC was given via gastric tube, a situation that can potentially stimulate the gag reflex and increase the risk of vomiting and aspiration.[19–25] In the 1 remaining case, aspiration occurred after multiple doses of AC had been given to a patient with persistent vomiting secondary to an elevated theophylline concentration.[26] This patient aspirated during an episode of vomiting that occurred during a sudden onset of seizures. In all of the published cases of AC aspiration, each of the patients had 1 or more of the following factors: depressed mental status, insertion of a gastric tube with an unprotected airway, and toxin-induced seizures.[19–26] Eight patients (6.9%) in our case series had spontaneous vomiting after administration of AC, and none reported evidence of respiratory difficulty after this episode. In alert patients with intact gag reflexes and no interference attributable to gastric tube insertion, the incidence of aspiration would be expected to be very low.[27]

This study has several limitations. Information concerning dose administered and potential complications were gained from careful questioning of parents of the patients by telephone rather than by direct observation. We thus relied on accurate parental reporting. We believe that because all patients were followed for 3 days, symptoms from any serious complications such as aspiration would have become evident. The estimation of dose was based on close questioning of how much, if any, AC remained in the bottle after they had completed the administration. In addition, this is not a study of the effectiveness of AC but rather of the acceptability of AC for home use and the ability of parents to follow advice.

Since the conclusion of this study, the poison center has managed an additional 229 patients at home using AC. In all 229 patients, there was successful administration of AC by the parent. In 1 additional case, the parent felt unable to administer AC in the home after an initial attempt by the parent and was referred to a local ED. All of these patients were followed for a minimum of 24 hours, and 145 patients (63.3%) were followed for 72 hours. There were no adverse events in these additional patients.

CONCLUSION

AC can be administered successfully by the lay public in the home. Home use of AC significantly reduces the time to AC administration when compared with those referred to an ED. GI decontamination at home using AC, in appropriate circumstances, may reduce the number of cases that require treatment in a health care facility.

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