

‘Char-cola’—Using cola to increase the palatability of activated charcoal: A review of the literature

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Activated charcoal (AC) is a porous carbon product formed by superheating carbon compounds. The process results in small particles with an exceptionally large surface area. The large surface area is clinically useful for its ability to bind with drugs, chemicals, and organic compounds. This binding or “adsorption” is useful in the clinical context because when ingested it binds with toxins and prevents gastric absorption, leaving the AC-bound chemicals to be excreted in feces (AACT/EAPCCT, 2005). Activated charcoal has been recognized as a gastric decontaminant since the early 1800s (Juurlink, 2015), and is still the most commonly used agent for GI decontamination in acute poisoning (Watson 2005). It’s used for a wide variety of poisonings and is generally quite safe; but getting patients, especially pediatric patients, to consume the medication orally can be difficult. This article will review the use of AC in poisoning: which ingestions it is useful for, the evidence to support its use, typical dosing of AC, and we offer evidence-based suggestions on how flavouring agents can increase palatability and patient adherence.

AC will bind with most drugs. It is effective for most poisonings. However, the adsorption process relies on weak binding and factors such as toxin volume, temperature, solubility/ionization of the toxin, pH, and the presence of other gastric contents. For this reason it’s easier to describe when AC is ineffective, or requires multiple doses, than it is to create an exhaustive list of drugs it will bind to. Strong ions, heavy metals and alcohols are generally not well adsorbed to AC (Olson, 2010; AACT/EAPCCT, 2005). Substances not well adsorbed by AC can be recalled by the “PHAILS” mnemonic: **P**esticides, **H**ydrocarbons, **A**cids and **A**lkalis, **I**ron, **L**ithium, and **S**olvents (Davis & Anderson, 2017). Although single dose AC is the norm, occasionally multiple doses of AC may be given to select patients (Eddleston et al., 2008). Drugs that may require multiple dose AC (MDAC) administration can be recalled by the mnemonic “ABCD”: **A**ntimalarials (quinine) and **a**minophylline (theophylline), **B**arbiturates (phenobarbital) and **B**eta-blockers (nadolol), **C**arbamazepine, and **D**apsone (Stephen et al., 2001).

The evidence to support AC use is of relatively low quality. Conducting randomized controlled trials (RCT) on poisoned patients is ethically and logistically challenging. As a result, the use of AC is not well supported with RCT evidence. In-vitro studies show that AC will strongly bind to common toxins (Juurlink, 2016). AC has also been shown to decrease serum levels with sub-toxic drug ingestions in volunteer studies when compared to control (Olson, 2010; Juurlink, 2016). These studies have shown AC to be effective in reducing rates of drug absorption by 30–63% depending on the drug and time of AC

administration (Olson, 2010). A meta-analysis of volunteer studies found that AC reduced drug absorption by an average of 38% if administered within one hour, and that it continued to be effective at four hours with a median reduction of 27.4% (Jürgens, Hoegberg, & Graudal, 2009). Although AC has shown to be effective at reducing absorption rates and decreasing serum drug levels, the two randomized controlled trials that have assessed AC have not shown a mortality benefit (Cooper, Le Couteur, Richardson, & Buckley, 2005; Eddleston et al., 2008). The RCTs should be interpreted with caution. In one, half the patients were poisoned with pesticides (and are likely not generalizable to pharmaceutical overdoses) (Eddleston et al., 2008), and in the other the patients were toxic with either acetaminophen, which has a direct antidote, or, benzodiazepines, which tend not to be actively treated (Cooper et al., 2005). Both studies had large numbers of patients with delays greater than four hours to AC administration.

The outcomes of case reports are generally positive and show several clinically significant, non-mortality, benefits of AC including: reduction in serum drug levels (AACT/EAPCCT, 2005); reductions in toxin-specific complications such as QTc intervals (Friberg, Isbister, & Duffull, 2006), hepatotoxicity (Chiew et al., 2017), rates of delirium (Page, Duffull, Whyte, & Isbister, 2008), and antidote dose requirement (Chiew et al., 2017). While the efficacy is a topic for debate, the general safety of AC is not, with complications tending to be outweighed by the potential benefits of judicious AC administration (Juurlink, 2016).

Although there is some disagreement on the efficacy of AC, it is generally agreed upon that the sooner AC can be administered after poisoning, the better the adsorption will be (AACT/EAPCCT, 2005). Usual doses of activated charcoal are 0.5-1g/kg for pediatric patients and typical initial adult doses of 50–100g with additional 50g doses potentially given every four hours (AACT/EAPCCT, 2005; Chiew et al., 2015). The evidence suggests that AC should not be given by nasogastric tube or used in patients who cannot maintain their own airway, because of the risk for AC aspiration and resultant pneumonitis (AACT/EAPCCT, 2005). The risks and benefits of AC should also be weighed for patients with, or at risk for GI perforation, as it may obscure endoscopic investigation of the stomach (AACT/EAPCCT, 2005). Ultimately, regional practice may be guided by specific institutional policies, and individual dosing may vary between patients and toxins. Clinical judgment is required.

Most patients will tolerate AC orally, but palatability, especially in pediatric patients, can present a significant barrier to timely

ingestion. A number of studies have examined the addition of flavouring agents to address this issue. The majority of these studies have investigated the palatability of mixing AC with flavouring agents such as yogurt, juice, milk or cola (Dagnone, Matsui, & Rieder, 2002; Skokan, Junkins, Corneli, & Schunk, 2001; Cheng & Ratnapalan, 2007; Groth Hoegberg, Christophersen, Christensen, & Angelo, 2005). Of the four studies identified, only one examined palatability for adults, and compared AC and yogurt versus AC and water, and found there to be no difference in palatability between the two mixtures (Groth Hoegberg et al., 2005). Pediatric studies, conversely, have consistently found cola to be the preferred mix for AC in terms of flavour, ease of swallowing, and overall preference (Dagnone et al., 2002; Skokan et al., 2001; Cheng & Ratnapalan, 2007).

There are concerns that the addition of flavouring agents could change the adsorptive capacity of AC (Scharman & Krenzlok, 1994). Research into this question has proven these concerns unfounded. In-vitro studies have evaluated the effects of adding ice cream, yogurt, or food mixtures on the adsorptive capacity of AC and the effect on clearing toxins, and have concluded that although food can impair AC adsorption of toxins by approximately 11–26% (Groth Hoegberg et al., 2005), the AC was still able to provide effective decontamination and clinical effect (Groth Hoegberg et al., 2005). Furthermore, when AC is mixed at concentrations greater than 5:1 the impairment of adsorption approached insignificance (AC 92% adsorption, AC and food 90%), suggesting that in a clinical setting the use of a flavouring agent or the contents of the stomach will have little effect on the action of AC. Moreover, when cola-AC was compared to cola-water mixtures in volunteer studies the cola-AC combination was not statistically different in its capacity to prevent acetaminophen absorption (Rangan et al., 2001).

AC is a generally safe drug, it's cheap, and can effectively bind with a great many toxins. But administering it in a timely way can be a challenge. Improving AC palatability by using cola as a

flavouring agent improves patient satisfaction, and may increase patient compliance. Improving its flavour with additives is within an emergency nurse's scope of practice, is well supported by research, and should be considered whenever administering the medication. Anecdotally, we have seen dramatic improvements in AC compliance in both the pediatric and adult populations when AC is mixed with cola. For children there is an improvement in flavour, the fizz is fun, and the colour of the cola doesn't change with the addition of AC. For adults there is less of a chance that allergies or aversions to dairy will present a barrier to using it as an additive. From a nursing perspective, cola is a clear winner as it's shelf stable, and readily available wherever there is a vending machine.

About the authors



Christopher Picard, CD, BSN, RN, ENC(C), has worked in tertiary, rural, and remote areas, as an emergency nurse, and in pre-hospital, clinical and austere roles domestically and abroad, as a medic with the Canadian Forces. He currently works as an emergency nurse at the Royal Alexandra Hospital in Edmonton, AB. His research interests are trauma care, evidence-based practice and knowledge translation.



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