Activated Charcoal Cocktails: What’s the (Potential) Problem?

William Copen, M.D.
May 20, 2017

Background

Activated charcoal (AC) is produced industrially by exposing charcoal to steam or hot air, which erodes the charcoal, and causes it to develop many microscopic pores. These pores give AC an extremely high surface area; a single gram of AC has about the same surface area as 3 or 4 tennis courts.

AC’s high surface area makes it very good at adsorbing (note the “d”) other substances. This basically means that things bind to the surface of the AC, and get stuck there. For example, AC-containing filters are used in vodka production to trap and remove dissolved compounds that impart unwanted flavors.

Doctors in emergency rooms sometimes use AC to treat patients who have swallowed poisons, or who have overdosed on an oral medication. In these situations, the patient either swallows AC, or has AC delivered into his or her stomach through a tube. The drug or poison in the patient’s stomach binds to the surface of the AC and gets stuck there, so that it can’t be absorbed (note the “b”) into the patient’s bloodstream, and it can’t make the patient sick. Eventually, the AC and the adsorbed toxin pass through and out of the intestines, and the toxin is eliminated.

The potential problem for bartenders is that the same thing happens when you serve your guest a drink containing AC. The AC in your cocktail can adsorb other substances that your guest swallowed previously (or will swallow subsequently), and prevent those substances from entering into your guest’s bloodstream. An AC-containing cocktail could block the body’s absorption of food nutrients, dietary supplements, or, most importantly, medications.

AC’s ability to block the absorption of a medication, and therefore the danger that an AC drink might pose to your guest, may depend on three factors: which medication your guest takes, the amount of AC that you put in your drink, and the amount of time between taking the medication and ingesting the AC.

Factor 1: Which medication?

AC adsorbs some molecules more effectively than others. For the chemically inclined, some rules of thumb are that AC tends to bind more avidly to relatively large, organic, nonpolar, poorly water-soluble molecules. Smaller, inorganic, and more polar molecules tend to be adsorbed less effectively. Highly dissociated salts are very poorly adsorbed.

Most medications are bound by AC to some degree. In 2005, the American Academy of Clinical Toxicologists and the European Association of Poison Centres and Clinical Toxicologists released this official position statement about AC:
The first appendix of that position paper summarizes the results of numerous human studies, involving almost 50 different drugs. There’s a huge amount of information in that appendix, but the bottom line is that AC was able to significantly block the absorption of almost every drug on the list. There are a few drugs, like lithium carbonate, that are not effectively bound by AC at all. But, realistically, when your guest orders an AC-containing drink from your menu, you’re not going to ask them to name all the medications that they’re taking, so you can check them against a list. You’ll have to assume that, if your guest takes any medications, their effectiveness may be diminished by AC.

Two additional points about what AC does and doesn’t do: (1) It adsorbs almost no alcohol. Your guest will not get any less drunk because you put AC in his or her drink. (2) The internet is full of claims that AC is, in general, a healthy thing to eat, because it somehow purifies the body, or “eliminates toxins.” These claims are false, unless you’re in the habit of eating poison regularly. In that case, taking an AC capsule at the same time as the poison might help to prevent your body from absorbing some of the poison. However, just don’t eat poison.

**Factor 2: How much activated charcoal?**

Doctors usually use a dose of 50 grams of AC to treat drug overdoses. The amounts of AC that are used to color cocktails are much smaller. I’ve found recipes on the internet that work out to approximately 280 to 1,700 milligrams of AC per drink, assuming conversion factors of 10 grams per tablespoon of AC, and 280 mg per capsule. This raises the question of whether the small amounts of AC that are used in cocktails are enough to cause any significant problems with medication absorption.

Scientists think of this question in terms of the ratio of the amount of AC to the amount of drug. For example, the 50g AC dose that is used to treat drug overdoses is based on the goal of blocking the absorption of up to 5g of an unwanted drug, and on a longstanding assumption that an AC:drug ratio of about 10:1 is high enough.

The graph that I’m posting as “Figure 1” is copied from an influential scientific paper that was published in 2009. It combines the data from many previously performed studies, and basically shows how much a person’s absorption of a drug is reduced by various AC:drug ratios. For example, if the ratio is 10:1, you can expect to the drug’s effectiveness to be reduced by about 53%. If the ratio is 100:1, the drug’s expected effectiveness would be reduced by 88%. Note that this graph lumps together previous studies that looked at many different medications, even though medications are adsorbed by AC with widely varying effectiveness.

This graph is important for the charcoal-wielding bartender for two reasons. First, it shows how much you can reduce AC’s dangers just by reducing the amount of AC that you use. If your guest takes a 100mg dose of a medication, and you serve them a cocktail with 1.5 g of AC in it, you can expect to reduce the medication’s effectiveness by up to 62%. But if you lower the
amount of AC in your drink to 280mg (one capsule), you’ll only reduce the medication’s effectiveness by up to about 25%.

Second, the graph shows that the medication-blocking effect of AC is strongly dependent on the potency of the medication that your guest takes. “High-potency” medications, like the antidepressant Lexapro, require only small doses to have their desired effects; a typical dose of Lexapro might be 10 mg. “Low-potency” drugs, like the antibiotic Cipro, require larger doses; a typical dose of Cipro would be 500 mg. If you serve a drink with 1 g of AC to a guest who takes 10 mg of Lexapro, you have an AC:drug ratio of 100:1, and the medication’s effectiveness could be reduced by up to 88%. But serving that drink to a patient taking Cipro results in a ratio of 2:1, and only a 24% reduction of the medication’s expected effectiveness.

It is very important to recognize that Figure 1 assumes that your guest takes their medication and drinks your drink at almost exactly the same time. In the real world, however, most people don’t bring their pills to the bar and wash them down with a cocktail. AC’s ability to block medication absorption decreases when the AC and the drug are swallowed at different times. This issue will be covered in the next section.

**Factor 3: Timing**

AC can only adsorb what it can touch. If your guest takes a pill and drinks your charcoal cocktail at the exactly same time, then the pill and the AC will slosh around together in the guest’s stomach for a while, and subsequently begin the long journey through the guest’s intestines together. This gives the AC a lot of time to contact and adsorb the medication in the pill. On the other hand, if your guest takes the pill several hours before or after drinking your cocktail, the pill and the AC will spend less time together in the guest’s stomach and intestines. If the time difference is big enough, their journeys won’t overlap at all, and there will be no adsorption.

Scientists have studied how AC’s adsorption of medication depends on the timing of AC ingestion, mostly because emergency room doctors need to know when giving AC to an overdose patient won’t be helpful. Most doctors won’t use AC to treat overdoses that happened more than 2-4 hours before the patient’s arrival in the hospital, because the potential benefits of the treatment are small, and are outweighed by its risks.

Figure 2 is a graph that I’ve copied from a 2011 scientific paper, in which the authors assembled results from the previous studies that were listed in the 2005 position paper that I mentioned above, and made a graph of how much AC blocked medication absorption when it was given at various times after medication ingestion. On the y-axis, “AUC” refers to the area under the serum concentration versus time curve, which is the usual way of measuring medication absorption.
effectiveness in these studies, and “%” refers to how much of the medication’s intended effectiveness is achieved despite the effect of the AC.

You can’t draw many firm conclusions from this graph, because it includes studies of almost 50 different medications, and very widely varying doses of AC, ranging from 0.5g to 50g. What you can see, however, is that the maximum amount by which AC can block medication effectiveness decreases as the time between swallowing the medication and swallowing the AC gets longer.

You can look up individual studies in the position paper that I’ve linked to, and see how much a particular dose of AC was found to block the effectiveness of a particular medication, after a particular time interval. However, I recommend caution when interpreting these results, because the rates at which food and liquids move through the digestive tract vary dramatically.

Here’s why: The stomach is basically an expandable holding tank, whose job is to store whatever food and liquids that you swallow, and release them into your intestine at a controlled rate that the intestine can handle. If your stomach is empty, and you swallow only liquids, then those liquids will pass into your small intestine immediately, and rapidly. You may have noticed this, the last time you drank alcohol on an empty stomach. However, if you eat solid food, your stomach hangs onto that food for about 20 or 30 minutes, liquefying it so that your intestines can work with it, before beginning to send it on its way. It then takes about 2.5 to 3 hours for your stomach to empty half of its contents, and about 4 or 5 hours for it to empty itself completely. Stuffing your stomach with a larger meal means that your stomach will take longer to empty, because its job is to deliver its contents to the intestine at approximately the same controlled rate no matter how much you eat. Stomach emptying occurs even more slowly when you eat fatty food. That’s because your intestine needs more time to digest fat, so it sends a signal to your stomach to slow down the delivery rate. I’ve seen studies where the stomach’s emptying time after a high-fat meal was about double that of its emptying time after a low-fat meal.

The human volunteer studies that I’ve seen generally try to achieve consistency among their volunteers, by asking them to fast before the study, and take both the medication and the AC on an empty stomach. That means their volunteers’ stomachs were emptying about as quickly as they possibly could.

Many of the guests in your bar won’t be drinking on an empty stomach. However, the implications of that for their safety depend on the order in which they arrange their dining and imbibing activities. The worst-case scenario would be if your guest eats a large, fatty meal, then sits down at your bar, orders a charcoal-containing drink, and takes a pill while drinking it. In that case, it might take 6 or 8 hours for the guest’s fat-engorged stomach to empty completely, and the AC will be sitting in there adsorbing medication the whole time. Even if that guest waits a little while between taking the pill and drinking your drink, that slowly-emptying stomach will
probably make the medical-blocking situation worse than if the guest had literally washed the pill down with your drink on an empty stomach.

The best-case scenario would be if your guest takes a pill on an empty stomach, waits at least half an hour or so, then eats a big fatty meal and drinks your drink. In that case, the pill will have slipped out of the guest’s stomach before they even sit down at your bar, and the fatty meal will make their stomach act like a road block. It will hold up the AC, and stop it from catching up with the pill in the intestines.

Because there are so many different ways a guest might combine big meals, small meals, drinking cocktails, and taking pills, I think it’s difficult to make blanket statements about how much time between an AC cocktail and taking a pill is enough time. The fact that different people’s digestive systems move at different speeds makes the situation even more complicated. In my opinion, for the vast majority of basically healthy people, an interval of about 8 to 10 hours should be enough to ensure that there’s no significant medication adsorption, no matter what your guest ate or will eat.

Conclusions and real-world implications

For reference, this table shows the results of all the studies in the AACT/EAPCCT position paper that used very small amounts of AC, like the amounts that you might use in a cocktail:

<table>
<thead>
<tr>
<th>Drug and Dose</th>
<th>AC Dose</th>
<th>Delay</th>
<th>Percent Reduction in Drug Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin, 500mg</td>
<td>1g</td>
<td>&lt; 5 min</td>
<td>10.0</td>
</tr>
<tr>
<td>Disopyramide, 200mg</td>
<td>2.5g</td>
<td>&lt; 5 min</td>
<td>59.0 and 77.4 (2 studies)</td>
</tr>
<tr>
<td>Indomethacin, 50mg</td>
<td>2.5g</td>
<td>&lt; 5 min</td>
<td>65.2</td>
</tr>
<tr>
<td>Mefenamic acid, 500mg</td>
<td>2.5g</td>
<td>60 min</td>
<td>36.0</td>
</tr>
<tr>
<td>Phenylpropanolamine, 50 mg</td>
<td>500mg</td>
<td>No delay</td>
<td>47.5</td>
</tr>
<tr>
<td>Salicylamide, 1000mg</td>
<td>1.5g</td>
<td>No delay</td>
<td>22.4</td>
</tr>
<tr>
<td>Salicylate, 500mg</td>
<td>2.5g</td>
<td>&lt; 5 min</td>
<td>30.2</td>
</tr>
<tr>
<td>Salicylate, 1000mg</td>
<td>1.9g</td>
<td>No delay</td>
<td>12.3</td>
</tr>
<tr>
<td>Sulphadoxine, 1500mg</td>
<td>2g</td>
<td>5 min</td>
<td>46.8</td>
</tr>
<tr>
<td>Tolfenamic acid, 200mg</td>
<td>2.5g</td>
<td>&lt; 5 min</td>
<td>96.5</td>
</tr>
<tr>
<td>Trimethoprim, 200mg</td>
<td>2.5g</td>
<td>&lt; 5 min</td>
<td>90.8</td>
</tr>
</tbody>
</table>

You can try to extrapolate from these results, and predict what might happen in real-world situations. Again, use caution in doing that, because the effects of delays between medication ingestion and AC ingestion will vary greatly, depending on who your guest is and what he or she has eaten.

Practically speaking, what will happen if your AC-containing cocktail does reduce the effectiveness of your guest’s medication? The very worst possible outcome would be that your guest effectively misses one dose of the medication (or two doses, if it’s a medication that’s taken several times a day). It will be as though he or she forgot to take that pill. For medications whose benefits accrue over a long time, like antidepressants or cholesterol-lowering drugs, that won’t make much of a difference. For medications that have an immediate, short-term effect, the
difference could be noticeable. For example, an infection might not respond as well to antibiotics, or the Advil that usually prevents a hangover doesn’t work as well as it usually does. For a few medications, missing a dose could have much more severe effects. In any case, your guest will probably be unaware that there are any potential risks associated with AC-containing cocktails, even after something bad has happened, unless you warn him or her yourself.

Written by William Copen, M.D.
May 20, 2017

This article reflects the opinions of the author and does not constitute medical advice.