

Episode 38: Death Cap Mushrooms - Amatoxins and the Erin Patterson Case

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Transcript

Hi everyone, welcome back to the Tox Lab. I'm Rebecca. I'm Rob. So Rebecca, you ever been foraging for mushrooms? No, can't say I have.

Foraging for any food? Blackberries? No I'm not that outdoorsy. No that's true you're not.

What do you mean by that? And another question, do you like beef wellington? Yeah. In case you haven't guessed already this week we're going to be taking a look at what has become quite a famous case, the Erin Paterson case, and taking a bit of a deep dive into death cap mushrooms.

Before we jump into today's episode if you want to stay up to date with our content you can find us on Instagram at @the_tox_lab. We also have a LinkedIn page and for those of you who don't use social media but still want to get in touch you can email us at thetoxlab@gmail.com. So the Erin Paterson case coming out of Australia very recently the trial has concluded. We're not going to dwell too hard on some of the finer details.

We're not going to get bogged down into guilt or innocence but we did want to have a look at some of the facts of the case because it's a very very unusual case as toxicologists to come across. Rebecca why don't you run us through some of the facts. On the 29th of July 2023 Erin Paterson cooked a beef wellington for lunch with her in-laws Don and Gail Paterson, Gail's sister Heather and her husband. The following day all four guests were admitted to hospital with suspected gastroenteritis.

They then subsequently developed liver failure which then developed into multi-organ failure. Gail and Heather sadly died in hospital five days after the lunch with Don dying a day later despite receiving a liver transplant. Ian did manage to survive but was in hospital for about seven weeks. Erin was then charged with three counts of murder and one count of attempted murder for which she was found guilty on the 7th of July 2025 after a 10-week trial and a week of deliberation the culprit was death cap mushrooms.

So as I say we're not going to get too bogged down into some of the finer details of the case but from what I understand actually the cause of death in these cases is not under dispute here. So four guests fell ill all having eaten the same meal three of them died one of them was very very unwell but did survive. Now this case really got global attention didn't it and there's a fairly good reason for that. It's actually not very often that a mushroom is your murder suspect.

So what are death cap mushrooms? So death cap mushrooms also known as Amanita phalloides. Sorry if I've completely butchered that. It's thought to be one of the most poisonous mushrooms and unfortunately resembles several edible species of mushrooms that can be easily mistaken for things when out foraging.

Death cap mushrooms contain a couple of different toxins that are responsible for their effects. So one of these is amatoxins, which are quite large multi-ringed peptides, the main ones being alpha-amanitin and beta-amanitin, and these mainly act to inhibit RNA polymerase 2 which is required for the synthesis of mRNA, microRNA and small nuclear RNA, and the production of these is essential for protein synthesis and a lack of these will prevent metabolism and cause cells to die and this often

happens in the liver.

It's the first organ that the toxin encounters after it's been ingested so that's the primary organ that's affected and interestingly these toxins aren't degraded with digestion or heat so cooking them doesn't render them inert. So I want to dive into the liver bit for a minute and explore a little bit why the liver is the primary site of the toxic effect.

Now a friend of mine recently and listener of the podcast actually said to me Rob what does the liver do and it actually was a very very good question you can come up with textbook answers can't you you can say it degrades poisons and it produces essential blood proteins and it creates bile for digestion but it's hard what the liver is really really good at is synthesizing proteins to perform all of these essential functions and as you say the amatoxins they bind to RNA polymerase and stop it working so you completely stop the liver being able to do what it does.

Crucially of course proteins are also responsible for the homeostasis within the cells themselves so fairly fairly quickly the cells stop being able to do their job and actually start dying. Another toxin found in death cap mushrooms is phallotoxins and these have a seven peptide ring structure and these are also highly toxic to liver cells but are not absorbed through the gut and aren't thought to play a role in how death caps poison people. And actually I just want to go back to a point you made that I completely disregarded they're not inactivated by heat. No.

So if you are foraging and you pick mushrooms and you cook them they will still be poisonous. Yes and I think that's part of what makes death cap mushrooms so dangerous is that when yeah by cooking and digesting them you're not going to get rid of the toxin. So death caps are relatively small mushrooms pale green or yellow cap white gills they're not what people think of when we think of poisonous mushrooms. Typically if I said to you what's a poisonous mushroom people so often imagine fairy tale toadstools red white spots they are also poisonous though nowhere near as poisonous as death caps.

Death caps actually just do resemble edible looking mushrooms and actually there are quite a few edible mushrooms that look very similar to death caps which is one of the problems. They grow pretty much worldwide native originally to Europe we think but found quite commonly in the US and obviously as the Erin Patterson case has shown us also present in Australia more than 90% of fatal mushroom poisonings are caused by death caps so they are overwhelmingly the majority. On average one person dies a year in North America as a result of death cap mushrooms and about 30 grams or half a cap is thought to be enough to kill a human.

So relatively little these aren't big mushrooms either. The symptoms of poisoning actually come in three phases the first phase normally about six to twelve hours after ingestion is a gastrointestinal phase so nausea vomiting diarrhea quite severe but could be mistaken for gastritis food poisoning.

12 to 24 hours later there's actually a latent phase or sometimes called the honeymoon phase where patients actually recover and the GI symptoms subside they start to feel a bit better but then two to five days later the real issues start happening liver failure kicks in develop all of the symptoms consistent with acute liver failure so jaundice disordered clotting you can get encephalopathy and also renal failure can also develop kidneys are also another highly protein synthesizing organ so they also can become quite susceptible to the amatoxins and normally by the time you get to the point where the liver has started failing it's often too late and death following liver failure normally occurs six to sixteen days after ingestion so quite a period of time and I think with that we'll say it's a problem in itself that people will have these like gastro symptoms we'll then feel fine and then we'll start presenting with jaundice and symptoms of liver failure and it's not always necessarily put down to the mushrooms they might have consumed days before so in terms of treatments if you know that you've ingested mushrooms that you shouldn't have quite early on gastric decontamination with things like

activated charcoal have been shown to be really effective but only if caught early and most people do present quite delayed so it's not always useful a lot of the treatments are mainly supportive so things like rehydration correction of like electrolyte imbalances acid-based disturbances medications to improve disorders of coagulation and there are some treatments out there that have shown to improve survivability IV silibinin from milk thistles has been shown to prevent uptake of amatoxin by liver cells and also stimulates DNA dependent RNA polymerases which increase the RNA synthesis and therefore protein and i found this to be really really interesting it's not often a herbal remedy because of course milk thistle has been used for a long time as a liver improving herbal remedy this isn't like aspirin where we've taken something natural and turned it into a drug this is almost straight out the plant extract showing a remarkable ability to actually not only block the uptake but actually enhance the enzyme that's being interfered with it's not readily available in the uk it's not licensed in the bnf i'm not sure how many hospitals will stock it interestingly it is licensed for use in germany okay i don't know whether germany do a lot of foraging and therefore need it i don't know i think the caveat with this would still need to be given quite early because you still need to block the uptake of the toxins of the liver which means you need to do it relatively soon after consumption yeah for sure a liver transplant is often the only treatment for a lot of these patients because the liver damage has already occurred and is quite severe yeah by the time the patient's presented often that's normally it isn't it liver transplant is really the only option and this isn't quite as uncommon as you might think some data out of also looking at acute liver failure occurring between 1994 and 2021 that resulted in liver transplant showed 21 people needing a liver transplant as a result of death cap mushroom poisoning whereas only 18 due to paracetamol toxicity for example so it is fairly common in some places wow okay we haven't really talked about this but i guess we should these are mostly foraging gone wrong right these are not often homicide no so there are some notable historic deaths that are thought to be due to death cap mushrooms so the roman emperor claudius was very fond of eating caesar's mushrooms and it was thought he'd been fed a meal of death caps or poison prepared for them and that had been added to his meal and that's what brought about his death charles the sixth of austria experienced quite severe indigestion after eating a dish of sautéed mushrooms which led to an illness that he died of about 10 days later and it's thought by historians that was the result of death cap mushrooms the timeline fits doesn't it and that did then trigger the war of the austrian succession so we have managed to find some poison control data haven't we that was published a little while ago looking at some of the death cap mushroom presentations and stats this is us data i believe yes this is from the california poison control system it possibly may not apply to places where they apparently forage mushrooms more like Warsaw so this paper looked at data from the california poison control system from january 2013 to february 2023 they used search terms including mushroom poisoning amatoxin and the latin name for death caps which i'm not going to repeat with ingestion as the route of exposure and management of these patients at a healthcare facility i just want to clarify something slightly ingestion as the route of exposure does that imply there are other routes of exposure i don't know whether there aren't only for mushrooms but they can narrow down the data as whether it's been ingested or whether it's like skin contact with mushrooms or of course this is calls to poison control centres so actually it's entirely reasonable that a parent may phone to say their child has picked a mushroom or something yeah and they've like got horrible skin reactions they're trying to limit it to death cap mushrooms which work through ingestion i understand thank you excellent so 61 calls of possible exposure where individuals had been evaluated at hospital were identified late fall to the end of winter it was the most common time of year for these calls and all but one were from northern california and they did seem to be seasonally clustered with december 2016 being quite a notable period for these calls i'm thinking to my geography but southern california is a bit of a different climate to northern california northern california is quite wet and woody from my understanding shout out if you are from northern california and want to correct us so out of the 61 calls five individuals did

develop organ failure three of which died including a 60 and 31 year old male and a 35 year old female who was treated with hemodialysis which wasn't successful and the other two individuals who did survive who developed the organ failure did end up needing liver transplant amatoxin-containing mushrooms were only diagnostically confirmed in about 23 percent of patients of the five that developed organ failure this was confirmed in 40 percent of those and was confirmed in 21.4 who didn't have organ failure and these were all confirmed by mycologists so i'm assuming that people had taken in bits of mushroom or had had photos of the mushrooms that they ingested and they were ID'd that way rather than through looking at the toxin in people's blood or urine because actually for a toxicology podcast we've actually talked relatively little about the analytical toxicology of these mushrooms haven't we i know we will jump into that in a moment ten of these individuals were below the age of four eight had spontaneously ingested mushrooms while outside but remained asymptomatic two of which were fed mushrooms and did develop symptoms with one of them requiring a liver transplant so in general across the 61 cases mostly men were affected with the average age being 34 years most of the ingestions involved raw mushrooms rather than cooked the majority of individuals consumed these without also consuming alcohol other potential liver toxins generic symptoms included nausea vomiting diarrhea and abdo pain those who developed organ failure had quite raised LFTs twice the upper limit of normal and raised INR which is a marker of disordered clotting so all suggesting their liver was not working as it should yeah and quite fitting with the timeline we know about mushrooms the time from ingestion to symptoms was documented in 44 cases and in 35 of those symptoms occurred between like six and 48 hours after ingestion with a median time of 12 hours and quite a few of these patients 15 in fact developed elevated liver enzymes before their arrival to hospital and that was between three and 96 hours post ingestion so again that delayed presentation quite evident in these cases so let's talk a little bit about testing for amatoxin as you said in that data set the cases that were confirmed as being related to death caps were actually confirmed by mushroom experts looking at the mushrooms rather than actual analytical testing and there's actually a couple of good reasons for this isn't there firstly not everywhere has got methods set up to test amatoxin this is not a common poison that most labs are going to be set up to test for but even if you have the best method in the world the time frame and delayed presentation between ingesting these mushrooms and actually ending up in hospital given that the toxin itself clears from the bloodstream relatively quickly and we're talking serum half-lives of about two to four hours sometimes quoted by the time somebody actually gets to hospital there's often no amatoxin left to be able to detect in the blood i think there have been some tests haven't there looking at urine and even a like a dipstick method yeah and i remember reading a paper in i believe it was chat about urine dipsticks for amatoxin but again with people presenting so delayed i don't know how useful they will be like if you get a negative dipstick result doesn't completely rule out the possibility of death cap mushrooms being involved we're actually going back to the erin patterson case i believe at least one of the patients did test positive for amatoxin is that right yeah in the case of don patterson who was the one who needed a liver transplant and still unfortunately passed away they did detect amatoxin so it was analytically confirmed so one of the other details that came out of the erin patterson trial and i know i said i didn't want to get too hard into details but this particular point caught my attention and it really got me thinking actually that some of the evidence related to phone location data and the use of an app which was set up for citizen scientists to document plant locations and other wildlife and natural things for the purposes of monitoring biodiversity yeah and it has come under a little bit of fire because there's suggestion that you could use the app to look up the presence of poisonous mushrooms if you had malicious intent and i'm really torn on this point because i see where both sides are coming from yeah i feel like the location of poisonous mushrooms should not be a secret but i also understand entirely why people say that we should be hiding the location of poisonous mushrooms yeah i think from my perspective i actually had a case going back a couple of years where you're just going to have to trust

me i had good intent i needed a hemlock plant and i was able to find one by contacting a friend who told me where a hemlock plant was now i'm qualified i feel like i'm okay but again you know that sort of information i could see how that could have negative implications in the wrong hands so i do see where both sides are coming from should dangerous foraging data be fully public i don't know that fully public i don't i'm really torn on whether like it's helpful or harmful and it entirely depends on who's hands is in it's completely fair there may not be a right answer to this question it's okay so another thought i have had relating to liver failure is that it's relatively well established that a decent chunk of acute liver failure that ends up in death or transplant something like 15 percent or so is actually of idiopathic cause no cause is identified the question that i have is is a chunk of these mushroom related oh that's a good point some of them might be especially with with people ingesting mushrooms and having sort of that delayed presentation it might not necessarily be put down to that event and therefore gets put down as idiopathic how many of those that relates to i don't know so i think this kind of leads us to one of the takeaway messages of this episode doesn't it if you are a doctor listening who works in emergency departments then you are faced with a patient who's got GI symptoms followed by liver failure or liver failure and they say they had GI symptoms a little while before i think do think mushrooms particularly if they are an outdoorsy person that's been out in the woods recently or perhaps even admits to foraging certainly ask the questions because i think there could well be a number of cases that are falling under the radar a bit just because of the time frame i think there is one obvious other take home message from this episode isn't there and that is if you are foraging for mushrooms and you're not sure what you picked up and you're not a mushroom expert maybe don't risk it yeah i think that's a really important point i'm all up for people enjoying nature's bounty but clearly death cap mushrooms are a very significant risk so i think we're going to wrap it up here i hope you've enjoyed listening this week and that you've found some of it insightful at least if you've seen cases of mushroom poisoning do get in touch hope you all have an amazing week and we'll see you next time bye