Novel Poxvirus in Proliferative Lesions of Wild Rodents in East Central Texas

[Announcer] This program is presented by the Centers for Disease Control and Prevention.

[Sarah Gregory] Today, I'm talking with Dr. Carolyn Hodo, a postdoctoral research assistant of veterinary integrated biosciences at Texas A&M University. We'll be discussing a new poxvirus that is affecting Texas rodents. Welcome, Dr. Hodo.

[Carolyn Hodo] Thanks. It's a pleasure to be here today.

[Sarah Gregory] First off, we're going to be talking about poxviruses, so tell us what they are.

[Carolyn Hodo] Sure. Poxviruses are a large family of different viruses. They're. . .they can infect many different species of birds, reptiles, and mammals, including sometimes humans. One of the most famous poxviruses is smallpox, which is. . .caused really severe disease in humans, but was actually eradicated thanks to vaccination campaigns. Another famous poxvirus is monkeypox, which caused a outbreak in the United States, back in 2003. And that outbreak was traced back to a shipment of infected African rodents that came into contact with pet prairie dogs that were sold in pet stores, and then the monkeypox virus infected dozens of people across the Midwest. In the past few years, though, with advances in molecular technologies, there have been several new poxviruses found, both in people and in wild or domestic animals.

[Sarah Gregory] I understand that you captured some mice with unusual features. What were they?

[Carolyn Hodo] Yeah. Our research team captured several wild rodents with growths on the tail or their feet. These were recorded as observations with notes like "tumor tail" and the animals were released. But then, in August of 2014, one of our collaborators captured a northern pygmy mouse, scientific name is baiomys taylori, and this mouse had really large growths on both the hind legs and the tail. So, the decision was made to euthanize that animal and then do further testing to determine the cause. So I looked at that mouse back in our lab, and it had three really large round growths on the bottom surface of its right hind leg, about two to three times the size of the animal's foot. And then it had another large growth on the top of the left foot and then another one on the tail. And each of the growths was about a centimeter in diameter. And this is a really small mouse; the whole mouse is only about 10 centimeters long. So these growths were really quite large compared to the size of the mouse. And then the second mouse that we discussed in the study was captured just last year, and had actually much smaller growths on the feet and the tail, they were only about one millimeter in diameter, so small that we probably wouldn't have noticed them if we weren't specifically looking for them because we had been already working on this virus.

[Sarah Gregory] Okay, so let me clarify, clarify for me here—where were you and why were you capturing mice in the first place?

[Carolyn Hodo] So, our research team, and we had some collaborators working on this project, as well, were working at two different field sites in East Central Texas. And the first field site is here in College Station, on the Texas A&M University property. And this College Station is

about an hour and a half northwest of Houston. And another site is about 80 miles directly south, on the Atwater Prairie Chicken National Wildlife Refuge, which is just west of Houston. And the rodents were being trapped as part of a study looking at tick-borne diseases. So, we weren't actually looking for this virus, we just happened to. . .these were side. . .sort of side notes, in addition to the tick-borne study. So, they were live-trapping rodents and then collecting blood samples in ticks. Then the rodents were marked with ear tags and released.

[Sarah Gregory] Okay, so it was these growths that alerted you to the fact that the mice had this unusual virus?

[Carolyn Hodo] Yeah, so when I first saw the photos of these growths, I was. . .so, I wasn't actually in the field with the team, but I was sent photos of the growths. And so I was suspicious of an infectious cause, like a virus. There are a few different types of viruses that can cause growths like this in other animals. And the fact that there were growths on several different individual animals made me suspicious of an infectious cause, more so than something like just spontaneous cancer. But then I couldn't find any previous reports in the literature of something like this being seen in wild mice.

But once they were able to collect and euthanize that really severely affected mouse, I performed a postmortem exam and then collected tissues to examine under the microscope, using histopathology. And inside the cells, I could see what looked like viral inclusion bodies, which are just sort of empty pink areas where the virus is replicating. But, at that magnification, I couldn't actually see. . .you can't see the virus itself, you can just see these sort of suggestive inclusion bodies. So, we went one step further and used an electron microscope, which has a much higher magnification, and allowed us to actually see the viral particles inside those inclusion bodies, and it turned out that they were shaped just like poxvirus.

[Sarah Gregory] So, this was a genetically distinct poxvirus, right? So how did you determine this?

[Carolyn Hodo] That's right. So, we. . .we could see that it was a poxvirus, but as I mentioned, there are a lot of different poxviruses out there. So, we needed to look at the genetic makeup of the virus, to see if it was the same or different from any previously that had been reported. So we used PCR, which stands for polymerase chain reaction, which is a technique that makes a lot of copies of a specific region of DNA, which can then be examined to determine the sequence of the base pairs in that region, and then compare it to others. So, we did that for a short fragment of one gene, taking our short sequence and comparing it to all of the other sequences in a large database called GenBank. And we found that it didn't match exactly to any of those other sequences. And it was only about a 75 percent match to other poxviruses, those were its closest match in the database.

So then to get more detailed information, we collaborated with some researchers in the poxvirus branch at the CDC to sequence the full genome of the virus, and then pulled out sequences of nine core genes, which gave us a much longer sequence of DNA that we could compare to previously reported viruses. So, we compared those nine core genes from our virus with the same nine genes from about 50 other poxviruses, that represented different groups or genera, and our virus didn't group exactly with any of those.

[Sarah Gregory] What was the virus you found, then, and how was it different from other poxviruses?

[Carolyn Hodo] Yeah, so we found that this poxvirus that we found in these mice was genetically different from any that had been reported previously. And using calculations to compare the genetic sequences of these viruses, we found that ours had a genetic distance of about 35 percent from other poxviruses, which is a really big difference. It's not just a species-level difference, but really a genus-level difference. So, we can say pretty confidently that this is a new species of virus, but I mean "new" as in previously undescribed. We don't how long it may have been present in mice in Texas, and just had gone unnoticed until now. It's also different because of the types of lesions that it causes. So that these types of proliferative skin growths are not really typical of many other poxviruses that have been reported. Usually, poxviruses cause more ulcerative lesions, so instead of something growing bigger, it erodes into the skin. Or they can cause proliferation of the tissues beneath the skin, but not of the skin itself, like we saw in, with this virus.

And so we named it Brazospox virus, because both of the field sites where we captured these mice are close to the Brazos River, which is a pretty famous river running through East Central Texas. And we chose that geographic name rather than naming it after the species of mouse, like Baiomys pox, for example, because we suspected it could be present in other species and we didn't want to isolate it just to that one species of mouse.

[Sarah Gregory] Could this virus be a threat to wildlife in Texas generally, and could it spread beyond Texas?

[Carolyn Hodo] Yeah, so that's a good question. We actually, right now, we're not totally sure of the geographic extent of the virus. So, we found it in these two field sites that are 80 miles apart, but as I mentioned, it was. . .that was kind of a side project that we just happened to notice them when we were capturing mice for other reasons, so we don't know the full extent of the virus already right now. And we also don't know what all species it's capable of infecting. So, besides the pygmy mice that we actually sampled in this study, we had field nites. . .field notes from that project that included two other rodent species that had similar growths. But we can't be sure if it's the same virus unless we actually get samples from those two. But it's possible that it can infect other species.

However, the poxvirus, besides causing those skin growths, didn't seem to cause any other lesions elsewhere in the body. So in most. . .and in most of those mice, the growths were small, although we did have that one mouse that we have photos of in the paper that had really severely, really large growths that probably did affect its mobility and maybe had some trouble getting around. But the mice that we captured in the field didn't seem to be sickened by the virus and there weren't lesions in the internal organs, though it's possible that we just wouldn't have come into contact with wild mice that were sick. That they, you know, if the mice were sick or dying of this, they might not have come into our traps and we would never encounter those.

[Sarah Gregory] Okay, so what about people?

[Carolyn Hodo] Yeah, I think that a lot of people seem to be concerned about that, that's a good question. It's really hard to say. So far, there's no evidence that it. . .that this virus can infect

people. There haven't been any cases reported and nobody that's on our team that handled these mice has gotten sick, although we do wear gloves as part of our field protocol when we're handling mice in the field and in the lab. And for sure, there are some poxviruses that can be transmitted between animals and people, and a lot of the newly discovered poxviruses in the last three years have been isolated from people. So, I wouldn't rule it out completely, but I would say at this time, it's probably not something that people need to worry about, but it is something that we can look into further.

[Sarah Gregory] I know that people get hantavirus from mice. Do you wear masks when you do this?

[Carolyn Hodo] That's a good question. So, we. . .we had a long discussion with our biosafety committee about whether we need to wear masks in the field working with these rodents. And the decision was made that we don't, because with hantavirus, the biggest concern is with old, dried urine that turns into dust and can be aerosolized. And so, if. . .they said that if we're working with, you know, live mice, fresh urine, out in open air environment, that our risk of getting hantavirus is much lower.

[Sarah Gregory] Okay. Alright, back to your study. Are there any conclusions from your findings and, if so, are there any next steps we should be taking?

[Carolyn Hodo] Our main conclusion is that, I mean, this is a novel virus that's unlike any that's been reported previously. It was also interesting that we found it in two different locations about 80 miles away, so farther than that individual mouse would be capable of traveling on its own. And also that we found it three years apart. We don't know how extensive the range is, as I mentioned, or how long it's been around in the environment, so we're interested in looking into that, as well as looking at the other species that it may be capable of infecting, besides just these pygmy mice. So, we can do future trapping efforts to look for the virus in different locations and in different species, and we can also use natural history museum collections to look for evidence of this virus in historic rodent specimens. So there may be some specimens collected, you know, 10 years ago, that are in the natural history collection, that have small lesions that weren't previously noticed. So we can, we can go back and look at those historic specimens. And also, our collaborators at the CDC poxvirus branch are working on growing the virus and cell culture in their lab, which would allow us to study it in a little more detail and use it for future experiments.

[Sarah Gregory] So, tell us about your job and why you became involved in this study.

[Carolyn Hodo] Sure. So, I'm a veterinary pathologist and a postdoctoral researcher studying epidemiology and disease ecology. I study, in general, transmission cycles of zoonotic diseases, so those diseases that are transmitted from animals to humans, and especially diseases that involve a wildlife reservoir. So, this project was actually a really cool side project to my main research focus, which is studying the vectorborne parasite Trypanosoma cruzi, which causes Chagas' disease in humans and dogs. But, as a pathologist, I've been trained to perform postmortem exams, or we call them necropsies, on animals and to identify diseases in a lot of different species. So, these rodents were captured for other studies, as I mentioned, that I wasn't directly participated in. But I was looped in because I'm a pathologist. They showed me the photos of the lesions that were seen early on, and I offered to help figure out the cause. So, to me

that was one of, really one of the coolest things about this project is that it stemmed from observations in the field that were combined with our collaborative team, which we all had different expertise. And so, if the field crew hadn't made note of those lesions and started asking, you know, questions about them and been curious, and then if the rest of our team didn't have the expertise to determine the cause, this virus wouldn't have been discovered.

[Sarah Gregory] Teamwork.

[Carolyn Hodo] Yeah.

[Sarah Gregory] Thank you so much, Dr. Hodo, for joining us today.

[Carolyn Hodo] Of course. Thank you for having me.

[Sarah Gregory] Listeners can read the June 2018 article, Novel Poxvirus in Proliferative Lesions of Wild Rodents in East Central Texas, USA, online at cdc.gov/eid.

I'm Sarah Logan Gregory for *Emerging Infectious Diseases*.

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