

# Human Neural Larva Migrans Caused by *Ophidascaris robertsi* Ascarid

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

[Sarah Gregory] Hello, I'm Sarah Gregory, and today I'm talking with Dr. Mehrab Hossain, an infectious disease physician in Australia. We'll be discussing a case of human neural larva migrans caused by the ascarid *Ophidascaris robertsi*.

Welcome, Dr. Hossain.

[Mehrab Hossain] Hi Sarah, thanks for inviting me.

[Sarah Gregory] Your article has gotten a whole lot of media attention. Articles in the press are calling it a brain worm. But I want to start with some basics first. What is *Ophidascaris robertsi* ascarid?

[Mehrab Hossain] It is a difficult one to pronounce, so it's *Ophidascaris robertsi*. It's a parasite or a nematode (a nematode means 'roundworm'). They have a distinct red color, and they are predominantly found in pythons, which are definitive hosts, and that means the parasite reaches its full maturity in the esophagus or the stomach of the python.

[Sarah Gregory] Where are these parasites found globally?

[Mehrab Hossain] So at this stage, the *Ophidascaris robertsi* parasites are predominantly found in Australia and Papua New Guinea.

[Sarah Gregory] And is it common for people to get infected with it?

[Mehrab Hossain] It is definitely not common to be found in people, and we have had just the one case for now. However, if infected, people are considered accidental hosts. What this means is people are not part of the parasite's lifecycle, and people have somehow ingested the parasite and it just continues to grow in that host. We are considered accidental hosts. It is not a typical lifecycle of this particular parasite.

[Sarah Gregory] Okay. So what is a human neural larva migrans and what are the symptoms?

[Mehrab Hossain] Neural larva migrans is a term that is used to describe a condition—so it's a condition caused by the migration of parasitic larva (larva are an immature form of a parasite). So they typically migrate from the intestine into the central nervous system or the brain of a host organism. In terms of symptoms, they can vary, but often includes symptoms such as headache, fever, vision problems, seizures, and in many severe cases they can have cognitive and behavioral disturbances as well. The severity of the symptoms can depend on the number of larvae involved and also where they are located in the brain, for example.

[Sarah Gregory] You just mentioned that people are accidental hosts. How do they get infected with it then?

[Mehrab Hossain] So the pythons shed the eggs of *Ophidascaris robertsi* parasites in their surroundings. And the eggs of the species are very sticky. The pythons leave their feces on vegetation. The eggs can then be eaten on plants or transferred from hand to mouth during foraging.

[Sarah Gregory] How serious is it? Can it be fatal?

[Mehrab Hossain] It can be a serious condition in people, depending on the organs they migrate to—they can travel to lungs, liver, spleen, and very, very occasionally the brain, making people very unwell. But please note that *Ophidascaris robertsi* infections are actually not common in humans to cause disease.

[Sarah Gregory] Since it's not common in people, is there a test for it?

[Mehrab Hossain] Unfortunately, again, given how rarely they infect people, there is no single test—I'll put it that way—to identify it. But there are other various indirect diagnostics that can aid in the search of this one; there are blot tests and cat scans that we can do. But once these worms are identified in people after very thorough investigation, they are then sent to the lab for identification and very smart machines do gene sequencing in order to identify what *Ophidascaris* species we are dealing with.

[Sarah Gregory] Okay. And once it's identified, what about treatment? Can it be treated and, if so, is there any recommended treatment?

[Mehrab Hossain] Today, we have ivermectin or albendazole. They are two antihelminths that can be used to treat this infection. These medications have also been used to treat other similar roundworms that are very well-known to infect people.

[Sarah Gregory] I've heard with other brain larva and parasites that it's dangerous, actually, to kill them inside the brain. Is this accurate?

[Mehrab Hossain] They are difficult to be killed, but it's not completely untreatable. There have been cases previously where there have been other parasites found in the brain. I don't know if you have heard of the term neurocysticercosis, but they have been treated with antihelminths as well or antiparasitic medication.

[Sarah Gregory] Your study is about a case of a person with this parasite in Australia, and apparently, the patient got it from a carpet python somehow. I think you said these parasites are commonly found in this species. Is it only this species or other reptiles?

[Mehrab Hossain] So these are commonly found in carpet pythons to our knowledge. We have not heard of any other reptiles at this stage. But it is possible.

[Sarah Gregory] Excluding people, as apparently, we should, mostly go through the cycle again of how the parasite is maintained.

[Mehrab Hossain] Sure. So the eggs of this parasite (*Ophidascaris robertsi*) are shed in the feces of the python and they are then consumed by marsupials like possums, koalas, etcetera and smaller mammals such as rodents. So the eggs then go through different stages of their growth in these smaller animals before getting consumed by the python snakes, again, where these parasites reach their full maturity—they become adults, basically. And basically, the cycle is completed within the snake, and the eggs are shed again in the surroundings and the cycle therefore continues.

[Sarah Gregory] It can't be transmitted from one reptile to another then?

[Mehrab Hossain] They aren't directly transmitted from one reptile to another. In other words, they aren't contagious.

[Sarah Gregory] Do environmental conditions have any influence on parasite transmission?

[Mehrab Hossain] So these parasites, like many other parasites, are incredibly resilient and are able to thrive in a wide range of environments. However, there's one study that shows that the eggs are resistant to harsh conditions like drought. And basically, they need a little bit of moisture to hatch and grow. So that could be a limiting factor.

[Sarah Gregory] So if the environment got hotter and drier, it might actually help in this case?

[Mehrab Hossain] Yes, yes. But usually, it's actually very hard to find an environment that you have no moisture at all, if you know what I mean.

[Sarah Gregory] Ah, I see. How would someone know if they were infected?

[Mehrab Hossain] I guess people will not be able to tell that they are infected with this parasite. But if infected, the patient still presents symptoms of chest infection or gastro-like illness, depending on the organs affected. And patients can have increase in eosinophil count—it is a type of white blood cell in the body (in the blood) —and once that's raised and, based on other symptoms and scans, the doctors will have to go through a thorough investigation, basically, in order to come to that diagnosis.

[Sarah Gregory] Let's talk more specifically about the person who got this parasite in her brain—tell us a little about her, how she got infected, and what prompted her to seek medical attention.

[Mehrab Hossain] Sure. So our patient was...who lives in the coastal part of New South Wales, she presented to the hospital with symptoms of chest infection and diarrhea. Initially, it was thought that she probably just had community-acquired pneumonia and then given antibiotics. However, the symptoms didn't improve, and she represented to hospital for further investigation and management.

[Sarah Gregory] What tests were done during this initial investigation?

[Mehrab Hossain] The patient underwent a lot of investigation. So when she presented, we found that she had a high eosinophil count (which is a type of white blood cell), and we performed scans (such as cat scans) and found abnormalities in the lungs and liver—so basically lesions in the lungs and liver. It did not show worms or anything as such, but she went through other investigations to identify the cause of the high eosinophil count in the blood. She had a biopsy of the lung lesion which just basically showed eosinophils in the lung tissue, but nothing else that suggested there were parasites.

So eventually, she was given a diagnosis of hypereosinophilic syndrome. It is basically a syndrome and usually it's caused by something, but what caused it remained unclear at that stage. We even looked for parasites in stool, we looked for antibodies to some of the common parasites in the blood, but they all came back negative. She was given immunosuppressive medications to treat this hypereosinophilic syndrome, including steroids that actually improved her respiratory symptoms. The eosinophil count came down and the changes in the lungs and liver started to disappear as well.

[Sarah Gregory] How did you eventually find this parasite?

[Mehrab Hossain] So about 18 months later since her first symptom onset, she saw a doctor for her worsening mood and depression, forgetfulness, that eventually led to obtaining an MRI of her brain. And that MRI brain showed an abnormal spot in the frontal part of her brain. So a neurosurgeon at Canberra Hospital performed an operation in order to get a sample from that

abnormal part of the brain, but instead found an alive and wriggling worm. This was immediately sent to our microbiology lab for further identification.

[Sarah Gregory] What was the initial reaction to finding it in her brain? I imagine it was a shock. Had anything like that been seen before?

[Mehrab Hossain] It was definitely a rather shock. It was a shock, for sure, for everyone, including the neurosurgeon who actually pulled it out. So one of my microbiology colleagues, Dr. Wilson, she received a phone call from the theater from one of the surgeons mentioning about this unexpected finding. It was sent to the lab, we had a look under the microscope, and it was still moving. It was fascinating. We could not identify the worm immediately, given it did not look like one of the more common worms that infect people. But we sent it to an expert parasitologist whose name is Dr. David Spratt, who has got 50 years of experience with many parasites. So he identified it immediately, given its color and other features. So essentially, it was a shock to everyone and a shock to the patient as well, but she took it really well.

[Sarah Gregory] Was there just the one? Or could there be other little ones lurking around in her head?

[Mehrab Hossain] So it was only the one. The neurosurgeon did mention she looked around a little bit because obviously she was there already so she had look, but she couldn't find any other string-like structures or anything as such. But having said that, she did a bit of a cleanup just to make sure there's nothing like small eggs still remaining.

[Sarah Gregory] So horrifying. What treatment was used, and did she eventually recover?

[Mehrab Hossain] The removal of the worm was the treatment in this patient. However, in order to kill the other eggs and larvae that I mentioned, which obviously weren't visible and could have been hiding in the body which were not obvious at that stage...I mean, we knew that there were...looking back, we knew that this parasite probably moved around through the lung and the liver. So who knows where else could it have been hiding. So based on that, we decided to give her two antiparasitic medications that I mentioned before—so Ivermectin, which has very good penetration to the brain and the central nervous system, and we also gave her four weeks of albendazole. In terms of recovery, she improved. She remained in the community and she's still well and there is no recurrence of respiratory or any gastrointestinal symptoms, and we have been monitoring her very, very closely in the clinic.

[Sarah Gregory] So no brain injury from finding this worm, pulling it out, looking around for eggs?

[Mehrab Hossain] Apart from some neuropsychiatric symptoms, she did not have any physical disability to begin with. So once we removed it, even after the operation, she did not have any neurological symptoms or such...there were no deficits. And the neuropsychiatric symptoms actually started to improve.

[Sarah Gregory] If this parasite hadn't been discovered, what would have been the long-term effects?

[Mehrab Hossain] This is a hard question. Basically, it's a bit unknown because obviously we have not seen this type of parasite before. But I presume if left untreated, her neuropsychiatric symptoms probably would have continued to deteriorate and the inflammatory response in the

brain due to the worm...if it would have continued to increase, that could have led to other neurological symptoms or disorder.

[Sarah Gregory] Do you think more cases like this will be recognized because of the attention to your study?

[Mehrab Hossain] There is definitely a possibility and cases may emerge, although very, very, very rare. There are other *Ophidascaris* species...not this particular species I'm talking about, but other species that infect snakes and other countries, especially in Asian countries. Because of how closely we interact with animals and their surroundings, other unknown parasites can start infecting people. I'd like to emphasize that not all headache or depression means that there is a worm in the brain. So to the audience out there, I would like to say not to panic, and if there are symptoms similar to what our patient has had, then you should be seeking expert opinion such as a doctor or a specialist.

[Sarah Gregory] Well, that's really good advice. So on that note, do we know how she even got this in the first place?

[Mehrab Hossain] Yes. As I was telling you about the eggs that are shed in the python feces, so what we think happened is because she lived in the coastal area, she lived by a lake and lots of warrigal greens (a type of a plant that you can actually cook and eat), and she like foraging so she would collect them, cook them (do stir-fries and things like that) and eat them. And she also mentioned after we identified this parasite that she had seen carpet pythons around where she lived, but she never had direct contact with them. And they are actually quite harmless snakes (carpet pythons). So what we think happened was she probably indirectly ingested it, either when she was handling utensils, collecting them, or cooking them and then eating the greens or the vegetation.

[Sarah Gregory] What further research do you think is needed?

[Mehrab Hossain] It's a new pathogen, essentially. Given how closely we interact with animals and the fact that there are a lot of known and unknown parasites out there in our environment and in the future we may see many other parasitic infections emerging and...I think we should have the capacity to investigate/manage these infections when they emerge and do further research.

[Sarah Gregory] Linking onto your study, how would you like this case to be used going forward?

[Mehrab Hossain] So I want our other medical professionals around the world to be aware of this new zoonotic infection and the challenges involved in making a diagnosis. As mentioned, it took 18 months for our patient to finally get that diagnosis, so...and there are similar worms in our environment or parasites in our environment that we should be vigilant and ensure early detection, prompt treatment and effective prevention measures, ultimately safeguarding public health worldwide.

[Sarah Gregory] I did a podcast with a person, Ben Taylor, in October of 2018 who also had a long battle with undiagnosed symptoms, and they turned out to be an eye worm called *Loa loa*. That was pretty horrifying too. Is this parasite similar to that one?

[Mehrab Hossain] I have actually heard...listened to that podcast, it was actually a very good one. But yes, so *Loa loa* is another type of roundworm, and so is *Ophidascaris*. But they are different. There are so many, you know, families and species...they are different. So the *Loa loa* is

contracted after a bite of an African deer fly and the larvae then migrates from the skin to the lungs and the eyes, whereas *Ophidascaris* parasite is contracted through oral routes. And their lifecycles are very different as well. The intermediate hosts are very different as well. So...I mean, they are similar in terms of the type (they are roundworms), but they are quite different and the mode of contraction of these are very different as well.

[Sarah Gregory] Just for our listeners out there who maybe haven't heard the other podcast yet, that was another astounding, horrifying moment when going through all this long period of no one figuring out what was going on with him—again, depression and that kind of thing. And then, one day he was looking in the mirror and he saw this little worm wiggling around in his eye. Can you imagine? I just like...that was the worst thing ever. The whole EID staff is traumatized by it, but now this brain worm is right up there with it.

[Mehrab Hossain] You never know, there will be other parasites. As I said, you know, they just emerge and we happen to find them out because poor patients just struggle and go through a myriad of symptoms and it takes a long time for us to actually find something like this because by then, they have actually traveled to other places.

[Sarah Gregory] Right. And it's so unexpected. So your article and your study will be a real help, I think.

Tell us about your job, where you work, and how you got interested in studying parasites.

[Mehrab Hossain] So I have recently become a specialist in infectious diseases. So where I was actually treating this patient (the patient with the *Ophidascaris* infection) and when I was writing the case I was an advanced trainee in Canberra Hospital in Australian Capital Territory. So I'm currently working at Eastern Health in Victoria, which is also in Australia. In terms of how I got interested, I've always been interested since medical school when I first learned about parasites causing malaria. So that got me interested and they are fascinating. And then when I became a doctor, I got to learn about other interesting parasites, and my interest just grew from there. This might sound gross, but some parasites are very, very pretty under the microscope.

[Sarah Gregory] That's so true of so many of these really terrible, awful things that will kill you or cause you such damage. When you look at them, they're so pretty.

[Mehrab Hossain] They are really pretty...colorful.

[Sarah Gregory] Yeah, I actually own two or three scarves (silk scarves) that have the designs of...one is *E. coli*, and I don't know what the other two are.

[Mehrab Hossain] I don't work in the microbiology lab as much, but the times I have been, I've thoroughly enjoyed my time. Even though they are very life-threatening diseases and infections, they are very pretty.

[Sarah Gregory] What an interesting conundrum. Okay, so out of all of the zoonotic diseases out there, is there one that worries you the most?

[Mehrab Hossain] To be completely honest, I couldn't choose just one. There's been so many zoonotic infections over the many, many, many years now. I am concerned about a few, especially when, you know, they become tough to handle or reach pandemic stages like the COVID-19 that we've been through. There are other zoonotic diseases such as Ebola, Zika virus, and they have previously raised significant concerns due to their potential for outbreaks and global impact. I guess what I'm trying to say is zoonotic diseases highlight the

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interconnectedness of human, animal, and environmental health, and they underscore the importance of effective public health measures (surveillance and international cooperation) to mitigate the impact.

[Sarah Gregory] Well, thank you so much for taking the time to talk with me today, Dr. Hossain. It's been a pleasure.

[Mehrab Hossain] It was wonderful. Thank you so much again for inviting, and it was an absolute pleasure as well.

[Sarah Gregory] And thanks for joining me out there. You can read the September 2023 article, Human Neural Larva Migrans Caused by *Ophidascaris robertsi* Ascarid, online at [cdc.gov/eid](https://cdc.gov/eid).

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

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