

A Parasite with Side Effects

Pork tapeworm infection is one of the major causes of epilepsy, which affects around 50 million people worldwide, mostly in the Global South. The condition is curable with the right treatment. Even better, however, is awareness raising and disease prevention as part of the One Health concept.



Tanzania

Gesamter Artikel (PDF, DE): www.tum.de/faszination-forschung-30

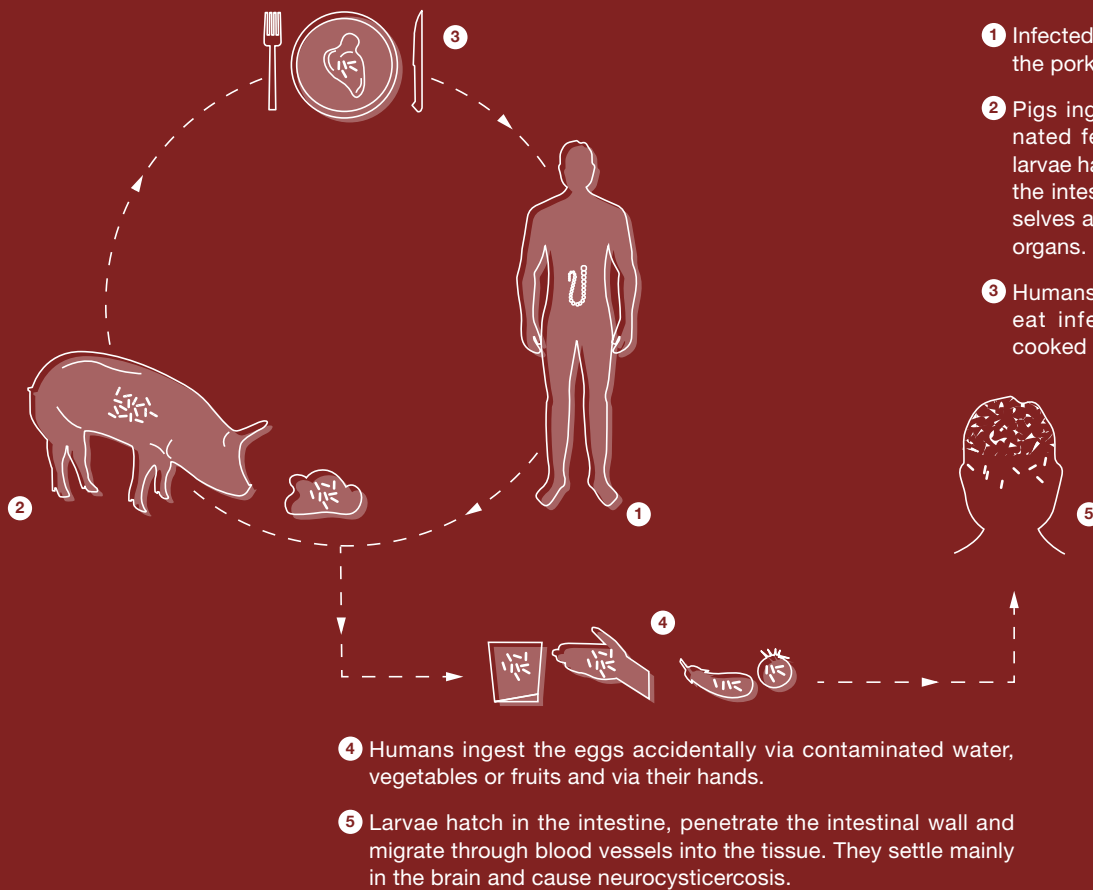
Ein Parasit mit Nebenwirkungen D

Neurologische Krankheiten haben weltweit die höchste Krankheitslast und die zweithöchste Mortalität. Prof. Andrea Winkler erforscht den Zusammenhang zwischen Epilepsie und Neurozystizerkose – einer Infektion mit Larven des Schweinebandwurms (*Taenia solium*) im Gehirn. Ihr Fokus liegt jedoch nicht nur auf neuen Diagnose- und Therapieoptionen, sondern auch auf verbesserter Prävention im Sinne eines One Health-Ansatzes. □

Link

www.med.tum.de/en/center-global-health-0

www.neurologie.mri.tum.de/de/arbeitsgruppen/globale-neurologie-neuroinfektiologie



- 1 Infected humans excrete the eggs of the pork tapeworm.
- 2 Pigs ingest the eggs with contaminated feces. In the pig's intestine, larvae hatch from the eggs, penetrate the intestinal wall and deposit themselves as cysts in muscles and other organs.
- 3 Humans ingest the cysts when they eat infected raw or insufficiently cooked pork.

- 4 Humans ingest the eggs accidentally via contaminated water, vegetables or fruits and via their hands.
- 5 Larvae hatch in the intestine, penetrate the intestinal wall and migrate through blood vessels into the tissue. They settle mainly in the brain and cause neurocysticercosis.

Neurocysticercosis: a major cause of epilepsy. The life cycle of the pork tapeworm (*Taenia solium*) includes humans as main hosts and pigs as intermediary hosts; through lack of hygiene and sanitation humans can become accidental intermediary hosts and develop neurocysticercosis.

In 2002, Andrea Sylvia Winkler traveled to Tanzania. While others went on a photo safari in the savannah, the young doctor wanted to help local people suffering from epilepsy. She soon noticed that very little was known about the condition and its specific local causes. Even today, more than 20 years later, the expert in global neurology at TUM is not letting go of the topic. "A large number of patients have hope of a cure," explains Winkler. Neurological disorders like epilepsy, stroke and dementia account for the world's largest burden of disease, have the second highest mortality rate, and increasingly affect the Global South. However, especially in low-income countries, these conditions often have different causes, resulting in a need for specific research. Unlike in Germany, for instance, around one third of all epilepsy cases in Tanzania are caused by an infection with *Taenia solium*, commonly known as pork tapeworm. This parasite lives primarily as a larva in the muscle tissue of pigs and as an adult tapeworm in the intestines of

humans. However, people can ingest the eggs of this tapeworm through contaminated water and food, and also through poor hygiene. The eggs hatch into larvae, each about half a centimeter to a centimeter in size, which can penetrate the intestinal wall and migrate to muscles, skin or especially the brain.

The larvae encapsulate themselves and are therefore not recognized by the immune system. Many patients remain asymptomatic for years, and have no idea that they are carrying a ticking time bomb. It is only when a trigger – which remains unknown – causes the immune system to attack the encapsulated larvae that an inflammatory response occurs, which can lead to neurological signs or symptoms including severe headaches, paralysis, a loss of intellectual capacity or even epilepsy. The medical term for this infection is neurocysticercosis (NCC).

A neglected tropical disease

The pork tapeworm does not only occur in Tanzania; other countries in sub-Saharan Africa, Latin America or Southeast Asia are also affected. Nevertheless, **NCC**¹ is one of the neglected tropical diseases. There has been little research in this area so far. Funding? Not a chance. In the beginning, Andrea Winkler has to convince donors that it is worthwhile to invest in research on the prevention and treatment of such poverty-related diseases. Her demand is clear: “We Europeans must take the issue seriously! We have a moral and social obligation to do so and we will see more and more NCC cases also in Europe due to migration. Moreover, research on NCC generates valuable knowledge that can be transferred to other neurological diseases.”

Since 2016, there has been genuine, major progress on the issue. Through funding from the German Federal Ministry for Education and Research (BMBF) and the EU, the SOLID and CYSTINET-Africa cooperation projects were launched. Andrea Winkler, who is now a Consultant Neurologist at TUM and Professor of Global One Health at the University of Oslo, is Co-Director of CYSTINET-Africa. Also on board is her colleague Prof. Clarissa Prazeres da

1 Neurocysticercosis (NCC)

is an infection with larvae of the pork tapeworm within the brain, which can cause neurological disorders such as epilepsy.

Costa from TUM, along with four research institutes and universities from Tanzania, Zambia and Mozambique. Together they want to find out how to better diagnose and treat NCC. At the same time, educational initiatives in local communities serve to raise awareness of the disease. One problem so far has been that NCC can only be diagnosed beyond doubt with neuroimaging such as CT or MRI. But the necessary equipment is expensive and rarely found in Africa. Within the framework of SOLID, an inexpensive and easy-to-use blood test was developed that provides very good indications of whether someone is infected with the pork tapeworm or not. Only those who receive such a positive blood test should subsequently be examined further. The test has already been explored in hospitals and under field conditions. The results have recently been published in *The Lancet Infectious Diseases*. ▶



During her stay in Tanzania, Andrea Winkler examines a child for possible neurological disorders.



Interdisciplinary research for better results

The special feature of both projects is their interdisciplinarity. “We don’t just see the problem as strictly medical,” says Andrea Winkler. A medical doctor herself, she knows the boundaries of her field only too well. Would it be possible to offer the millions of people who suffer from NCC adequate treatment with expensive medications and complex surgeries? Unfortunately not. But could new infections be prevented or at least reduced? Now, that’s feasible.

With this in mind, Winkler takes a step back – to a point in time before an individual even requires treatment. That is why veterinarians and social scientists are part of the project team. Working together, these experts discuss where the problems lie and where improvement is needed. Together with political representatives and other decision-makers, they develop policies that are later adopted by local and global decision-making bodies such as the World Health Organization (WHO). “Our focus is not only on treatment but also on prevention, because, although treatment is possible, it is expensive,” explains Winkler.

“We Europeans must take poverty-related diseases seriously. We have a moral and social obligation to do so and we will see more and more NCC cases also in Europe due to migration.”

Andrea Sylvia Winkler

Experts travel to the villages and talk to local people about the spread of the parasite and how to contain it. This includes not eating raw pork, treating sick animals with low-cost deworming medication and keeping animals in pens rather than allowing them to roam freely through the villages where they could become infected by ingesting the feces of people carrying the tapeworm. The overarching concept behind these efforts is the Global One Health approach, in which human health is only possible when animals and the environment are also healthy.

To get closer to this goal, Andrea Winkler founded the Center for Global Health at TUM in 2017 together with Clarissa Prazeres da Costa, supported by the Department of Neurology and the Institute of Medical Microbiology, Immunology and Hygiene. The CGH aims to initiate research and teaching projects on the topic of global health, bringing together specialists from various disciplines: “We’re moving beyond the national framework and collaborating worldwide.” ■

Claudia Doyle



Prof. Andrea Sylvia Winkler

studied medicine at LMU Munich, where she also completed a doctorate in neuroscience. She received a second doctorate in clinical neurology from the University of London. She became a Consultant Neurologist at TUM in 2011 and, later, a co-founding Director of the TUM Center for Global Health together with Prof. Prazeres da Costa. Winkler accepted a professorship in Global One Health at the University of Oslo in 2016. In May 2023, she started a visiting professorship at Harvard Medical School. One focus of her work is research into neglected neurological diseases in sub-Saharan Africa together with the One Health concept.
