

PARASITES AND PIGS: STUDIES IN NOVEL DIAGNOSTIC METHODS OF NEUROCYSTICERCOSIS



Image 1 (above). Adult *Taenia solium* tapeworm¹

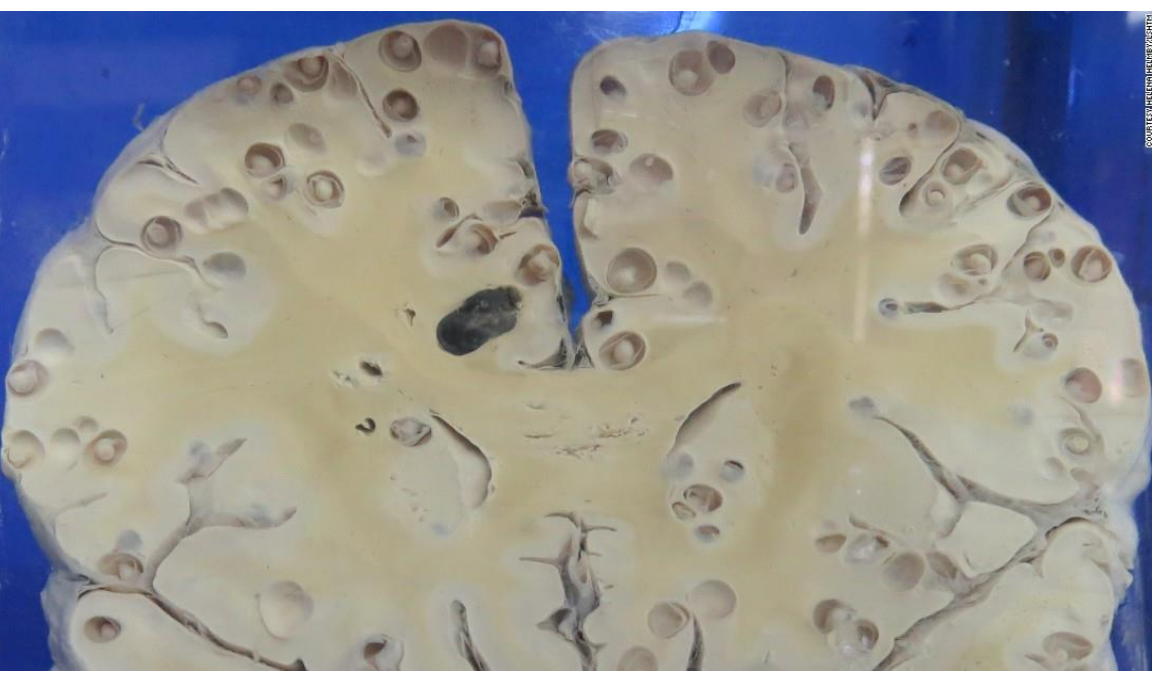


Image 2 (above). Human brain with neurocysticercosis depicting dozens of *T. solium* larval cysts²

THE PARASITE: *Taenia solium* is an intestinal tapeworm that is transmitted faecal-orally from pigs to humans and resides in the gastrointestinal tract. Larval cysts of this parasite can invade and lodge in the brain, causing a disease called **neurocysticercosis** (NCC). This condition causes neurological symptoms such as severe headache and seizures, and is a common cause of epilepsy in developing countries of South America, Sub-Saharan Africa, and Asia.

THE PIG (first summer): The pig is the intermediate host and the only other animal naturally infected by *T. solium*. Since the pig plays an integral role in propagating the life cycle of the parasite, studies have been performed to diagnose, treat, and vaccinate pigs at the farm level to break the cycle of infection.

My study focused on a diagnostic test using new antibodies looking for parasite-specific antigens in the serum of pigs in an assay called ELISA³. Pigs were obtained from endemic areas in rural Peru and diagnosed with this new assay. Its specificity and sensitivity were compared to the current gold standard, a blot called EITB, and to detection of cysts on necropsy.



Image 5 (above). Calcified NCC cyst in pig brain visualised with Masson trichrome staining

THE HUMAN (second summer): Definitive diagnosis of NCC in humans requires brain imaging such as MRI or CT, which are often unavailable or extremely costly in endemic areas for patients that may have the disease.

In India, a country that seldom consumes pork but still farms pigs which transmit NCC, the appearance of NCC on brain imaging is a single cyst rather than the multiple cysts seen on image 2. As a result, these images can be confounded with other endemic diseases such as tuberculosis (TB) of the brain.

My study investigated gene upregulation of 15 target genes in monocytes⁴, an inflammatory cell involved in the first-line defence of NCC and TB infections. Blood samples were taken from 12 healthy volunteers. Monocytes were isolated, cultured, and stimulated with BCG, PPD, or *T. solium* antigen to mimic either TB or NCC infection. The level of each target gene was measured by PCR amplification and analysed for specificity to TB or NCC.

THE FUTURE: The goal is to produce diagnostic tests for NCC that are
-Cheap: affordable for the patients in rural endemic areas of developing countries
-Accessible: sample needed from the patient is easy to obtain, has minimal risks, and is as painless as possible
-Reliable: makes a diagnosis which is sensitive and specific for NCC
 These tests can then be widely implemented in endemic countries to accurately diagnose NCC infection in the population.



Image 6 (above). Cow outside Christian Medical College

VELLORE, INDIA

Risk factors for NCC prevalence:

- free-roaming pigs
- open-air defaecation (humans AND pigs)
- regular interaction between humans and pigs
- poor hygienic practices
- undercooked meat consumption

These are often rural areas of developing countries.



Image 3 (above). Alpacas on the campus of San Marcos University of Veterinary Medicine

LIMA, PERU

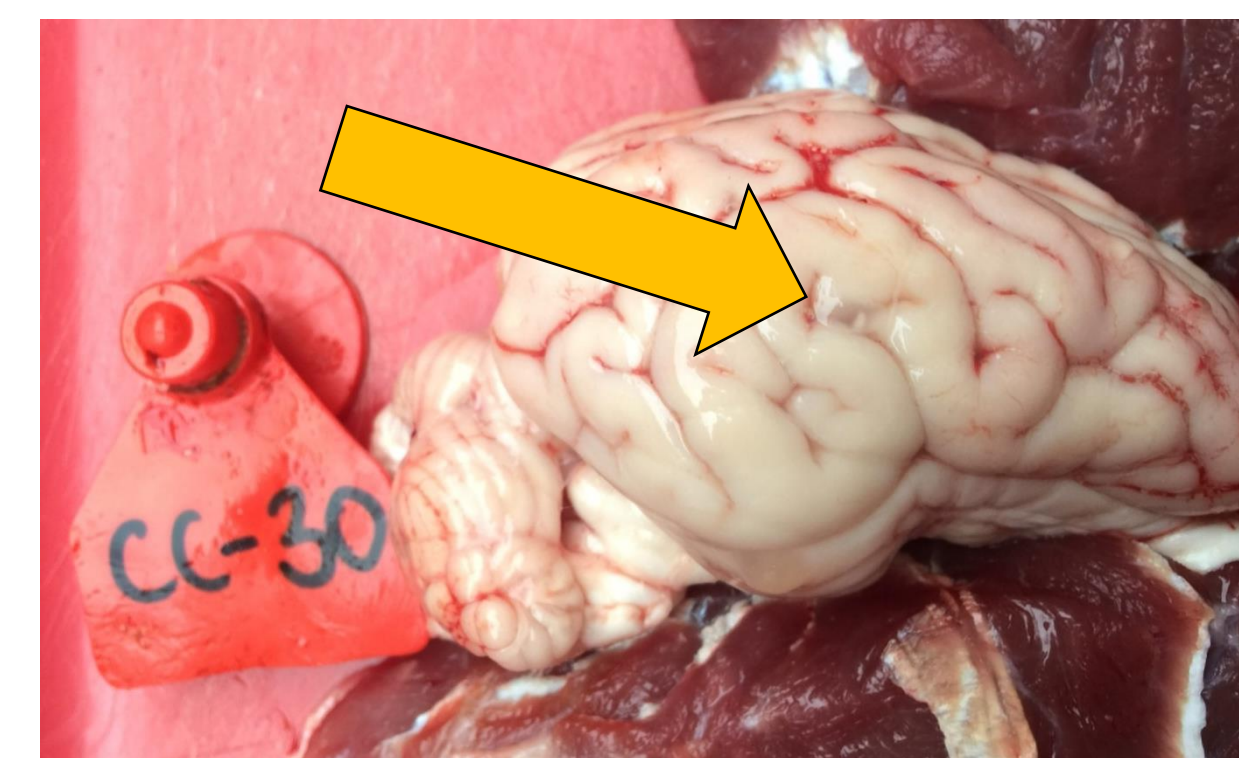


Image 4 (above). Subarachnoid cyst visualised on pig brain

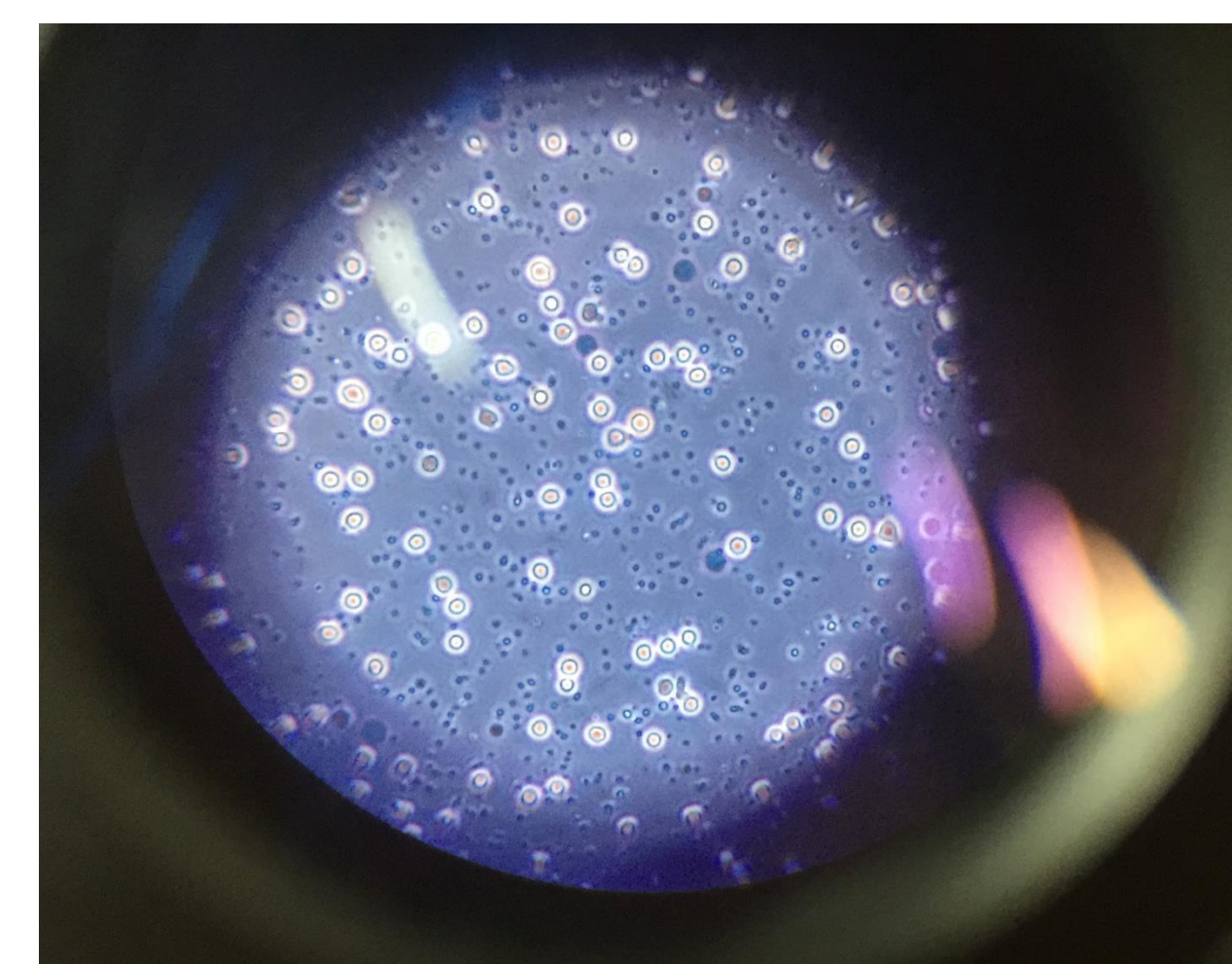


Image 7 (above). Monocytes isolated from subject's blood

References

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2. "The Worms That Invade Your Brain." CNN, Cable News Network, 20 Jan. 2015
3. Bustos, Javier A., et al. "Performance of a Sandwich Antigen-Detection ELISA for the Diagnosis of Porcine *Taenia Solium* Cysticercosis." *The American Journal of Tropical Medicine and Hygiene*, vol. 100, no. 3, 2019, pp. 604–608.
4. Prabhakaran, Vasudevan, et al. "Comparison of Monocyte Gene Expression among Patients with Neurocysticercosis-Associated Epilepsy, Idiopathic Epilepsy and Idiopathic Headaches in India." *PLOS Neglected Tropical Diseases*, vol. 11, no. 6, 2017

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