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Parasitosis and Nervous System

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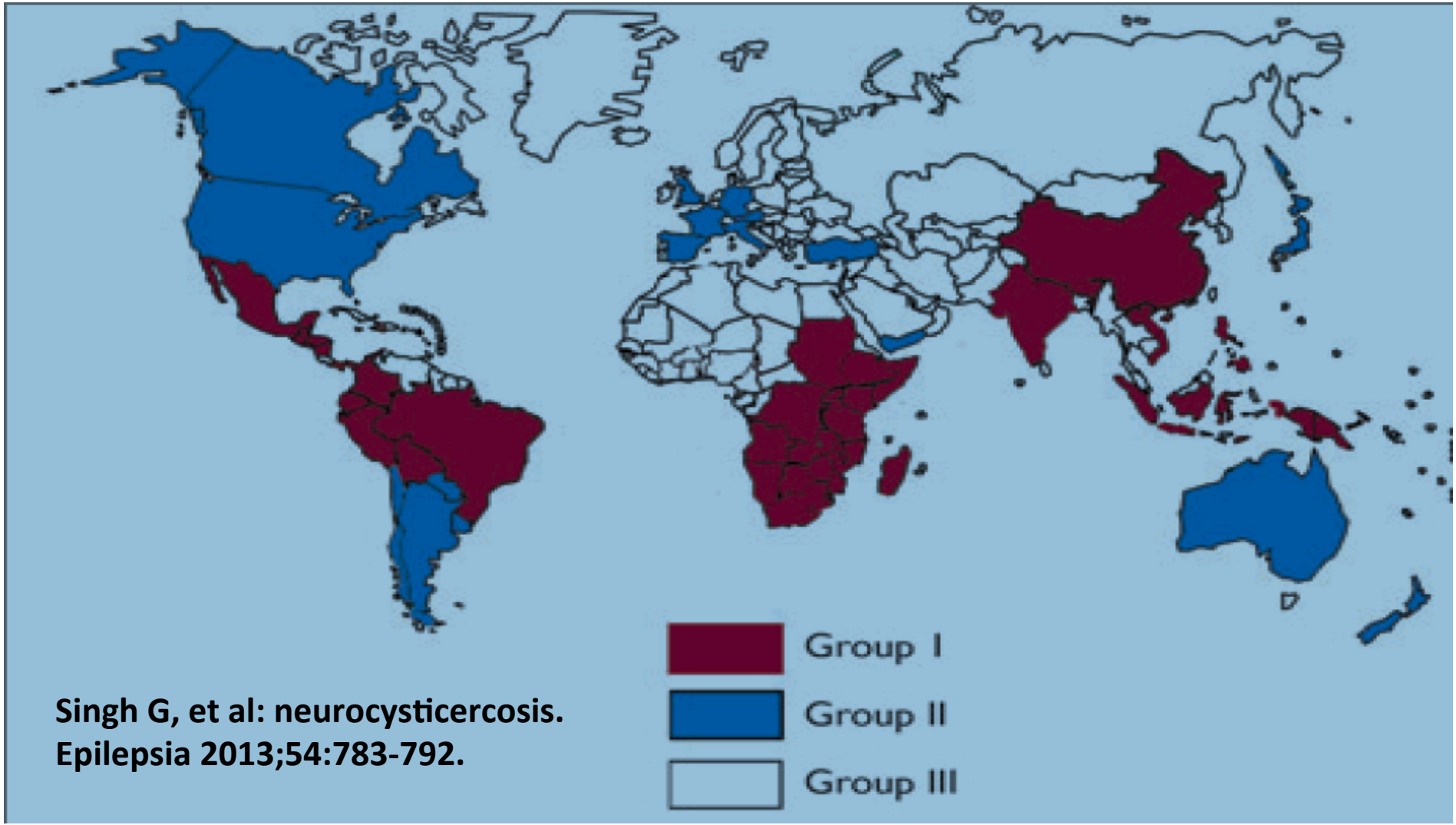
Disclosure: None

Parasitic infections of the central nervous system

PROTOZOA	METAZOA
Malaria	Flatworms: Trematoda: Schistosomiasis; Paragonimiasis
American Trypanosomiasis	Flatworms: Cestoda: Cysticercosis; Coenurosis; Hydatidosis; Sparganosis
African Trypanosomiasis	Roundworms or Nematoda: Gnathostomiasis; Angiostrongyliasis; Toxocariasis; Strongyloidiasis; Filariasis; Baylisascariasis; Dracunculiasis; Dicronemiasis; Lagochilascariasis
Toxoplasmosis	
Amebiasis	
Microsporidiasis	
Leishmaniasis	

- Parasitic diseases are distributed worldwide, with increased prevalence in areas of poor sanitation
- Sporadic cases occur in nonendemic areas due to increase in international travel and immunosuppression or HIV infection

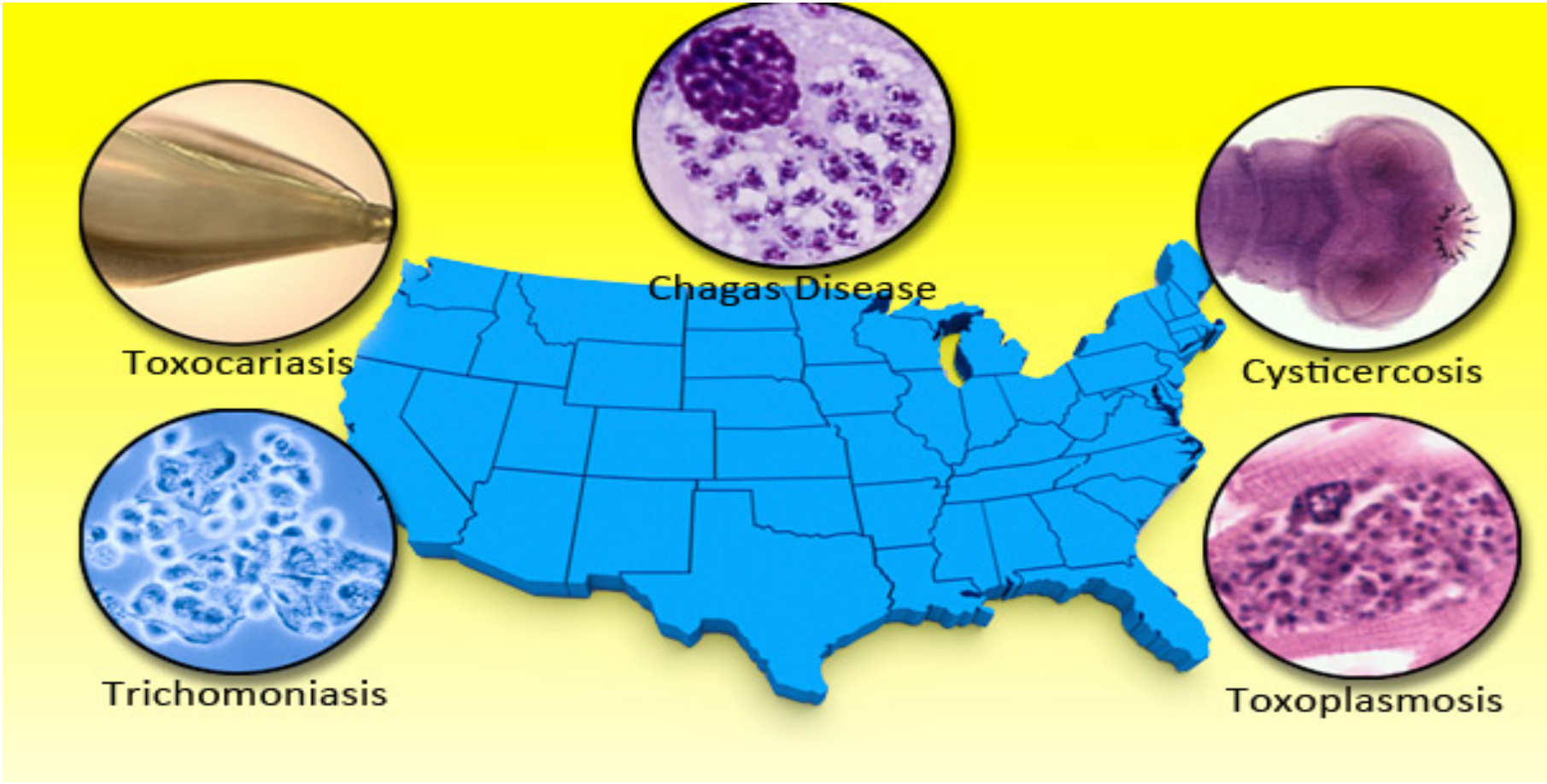


Singh G, et al: neurocysticercosis. Epilepsia 2013;54:783-792.

Most common parasitic infection of the CNS: cysticercosis

Less frequent infections: toxoplasmosis echinococcosis schistosomiasis

Rare: sparganosis, paragonimiasis, malariasis, amebiasis, toxocariasis, trypanosomiases

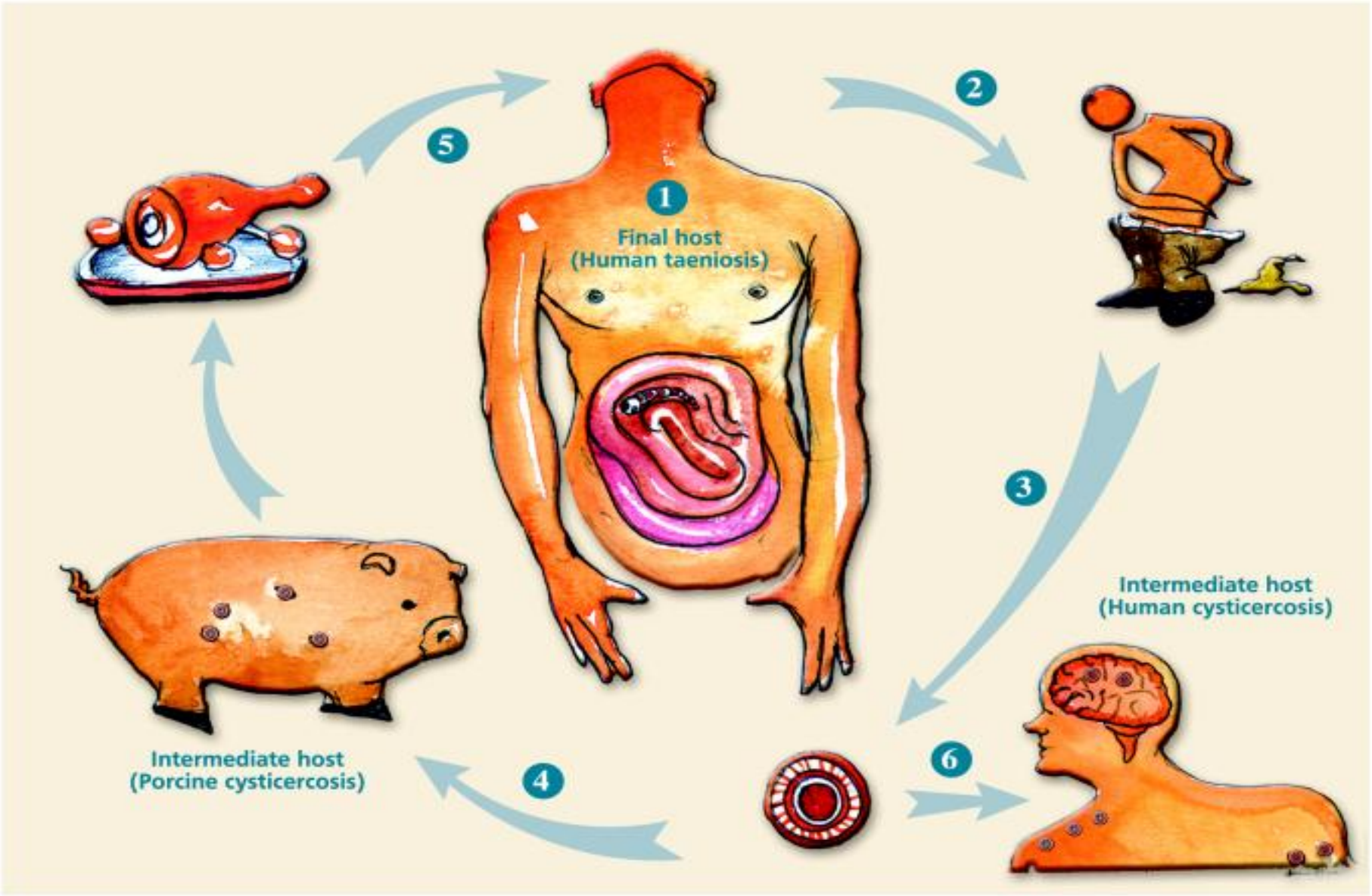


Neglected Parasitic Infections in the United States (Parise ME, CDC Atlanta, 2014) *

Parasitic infection of the CNS

Parasitic disease	Treatment	Endemic region	Estimated global prevalence
Chagas disease	Benznidazole and nifurtimox	Latin America	7-8 million
Schistosomiasis	Praziquantel	Sub Saharan Africa, Latin America and Asia	240 million
Taeniasis/ cysticercosis	Praziquantel Albendazol	Africa, Asia, Latin America	50 million
Echinococcosis	Surgical or percutaneous intervention and albendazole	China, Russia, Europe, North América	1 million
Paragonimiasis	Triclabendazole or Praziquantel	East-South Asia, West-Central Africa, Central-South America	23 million

Lyfe Cicle of Taeniasis/Cysticercosis *

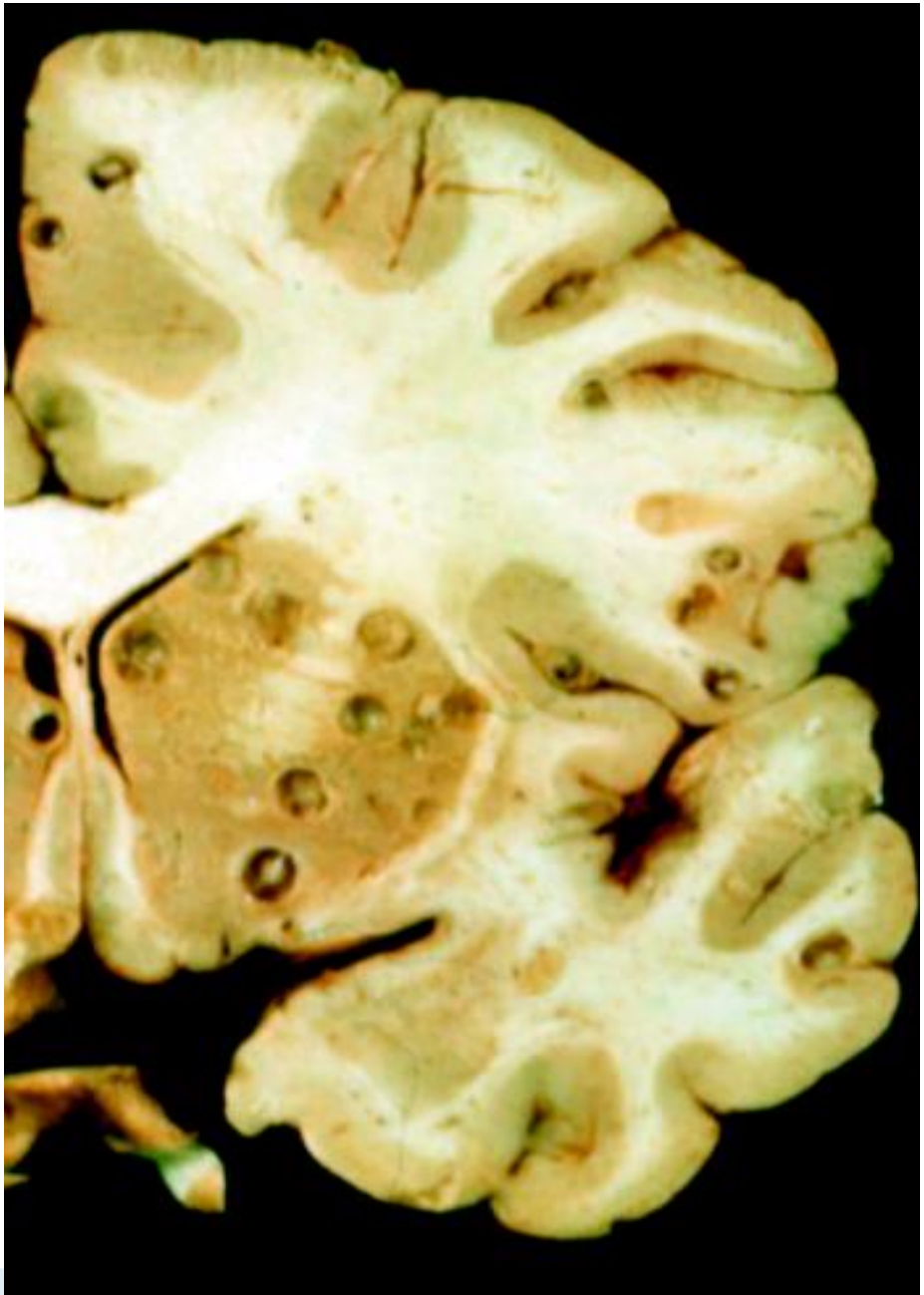


* Carpio A. Neurocysticercosis: An update. Lancet Infect Dis. 2002;2:751-762

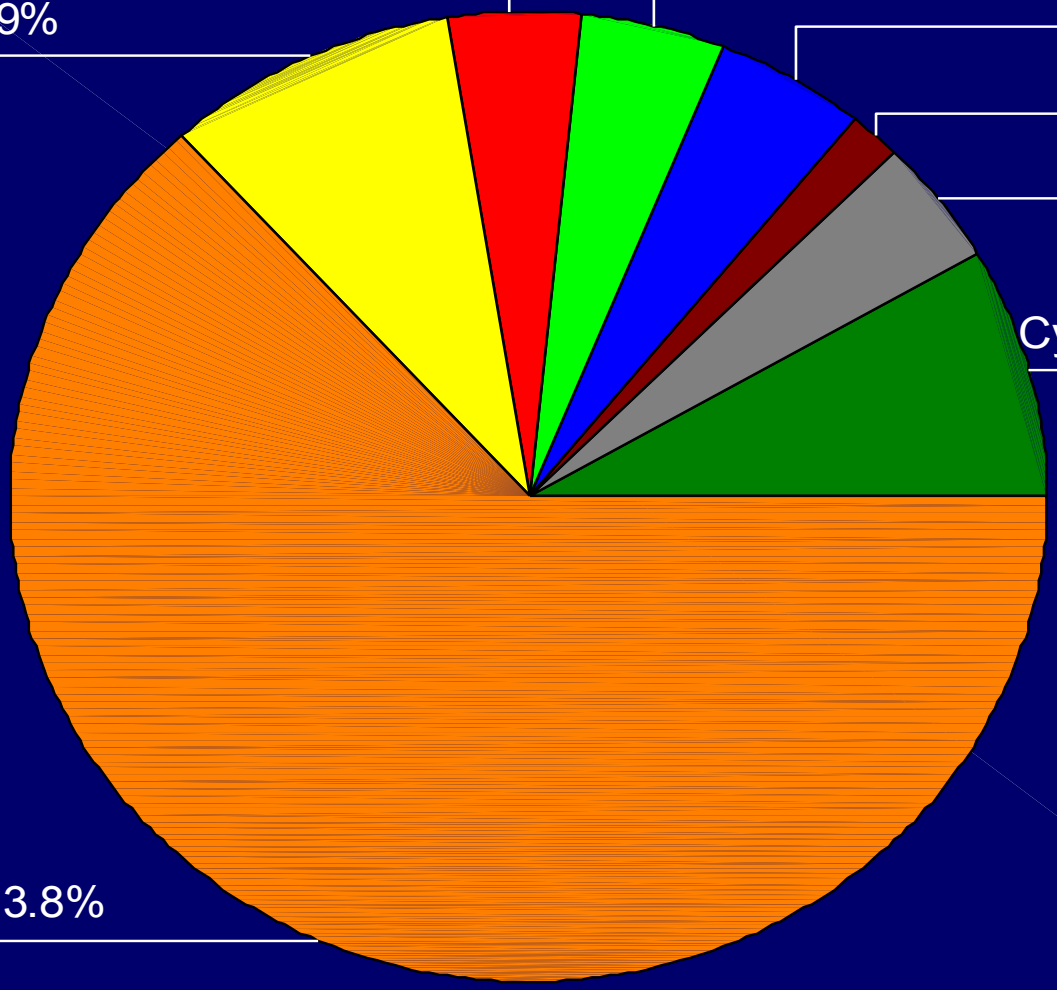
Clinical manifestations of NC

- Diagnosis of NC can't be carried out on clinical grounds alone, since there are no specific clinical manifestations of NC.

- Seizures, headache, focal motor deficits, and psychiatric and cognitive symptomatology are the most frequent clinical manifestations



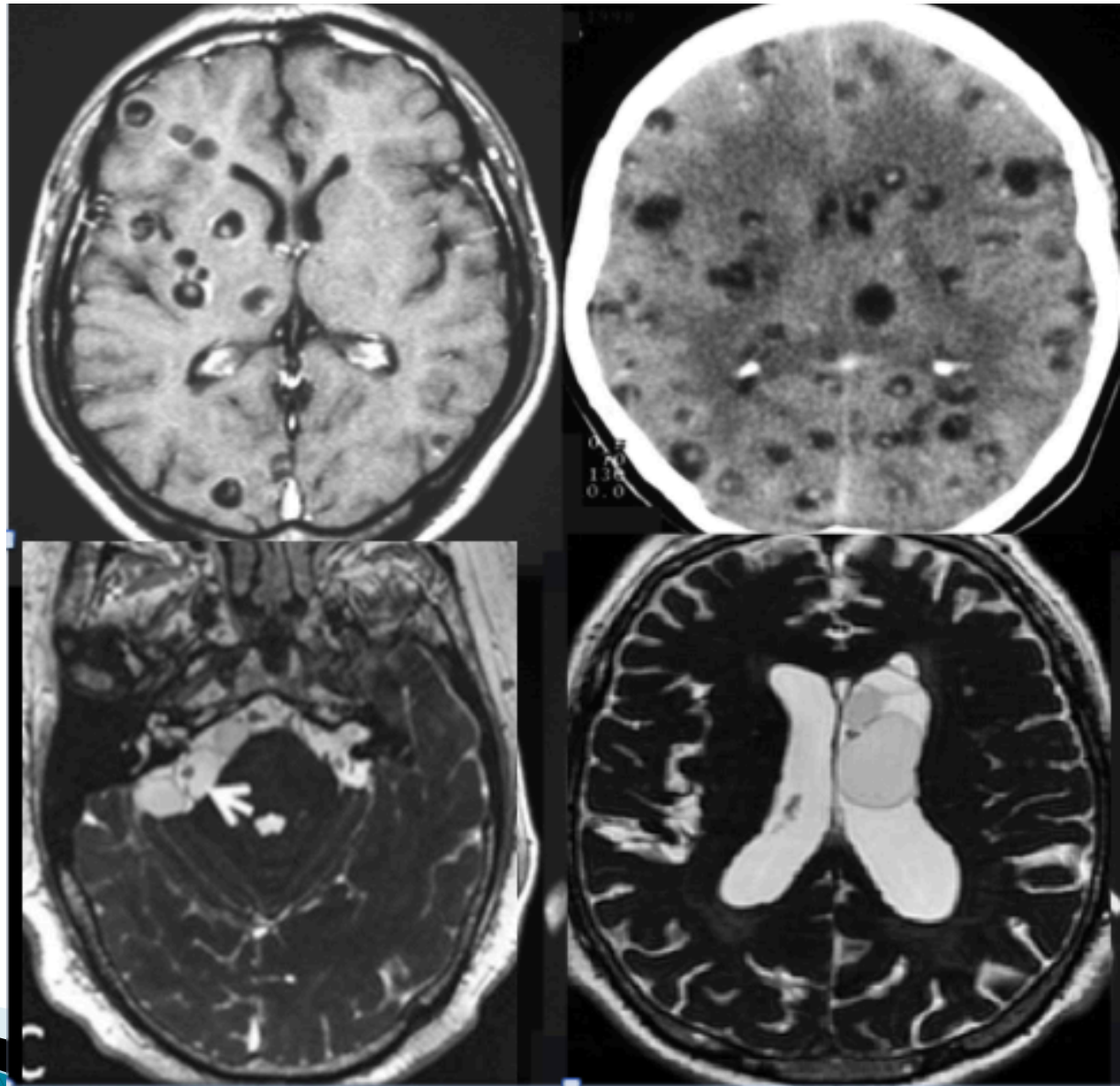
Etiology of Epilepsy in 310 patients in Ecuador



*** Bharucha NE, Carpio A, Epidemiology of Epilepsy in Developing Countries. In: Engel P, Pedley T. Epilepsy. A Comprehensive Textbook. Raven Press 2009**

Diagnosis of Neurocysticercosis

- CT scan and MRI are the main tools in NC diagnosis (gold standard) *
- MRI is superior for intraventricular or subarachnoid cysts, while CT is better for calcifications
- Typical image: viable cyst with a mural nodule (scolex) - multiple cysts in different pathological stages



Immunological tests

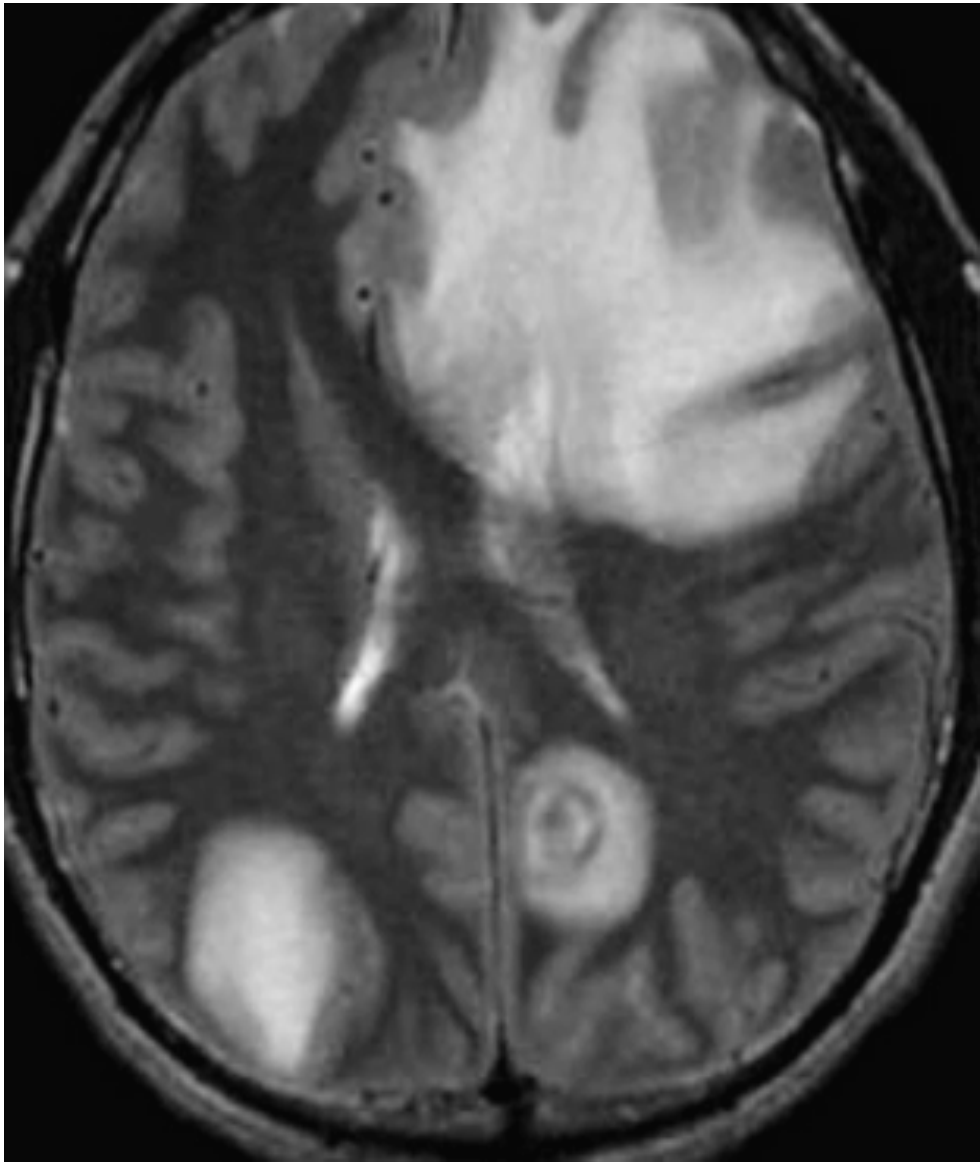
- Enzyme-linked Immunosorbent Assay (ELISA) and Enzyme-Linked Immunoelectrotransfer Blot (EITB)
- ELISA test for antibodies or antigen detection have showed higher sensitivities and specificities in CSF than in sera
- Sensibility of either tests falls in cases of single cysts in parenchyma or when they are calcified
- In patients with reliable diagnosis of NCC by imaging studies, immunological test is not required (a negative test will not discard a NCC)

Effects of Cysticidal drugs on resolution of Parenchymal viable cysts

Study / Reference	Treatment	Disapperance of cysts on CT scan at 6 m n/n %
Garcia H, et al. *N Engl J Med* 2004	Albendazole Placebo	21/55 (38%) 8/54 (15%)
Carpio A, et al J. Neurol Neurosurg Psychiat. 2008,	Albendazole Placebo	18/51 (35%) 6/50 (12%)
Das K, et al. J Clin Neurosci. 2007	Albendazole Placebo	10/148 (7%) 12/150 (8%)

Toxoplasmosis

- **CNS manifestations may occur as a consequence of congenital infection; encephalitis or mass lesions in AIDS and the immunosuppressed.**
- **Patients develop inflammatory, necrotic lesions, causing diffuse and localized symptoms: headaches, confusion, focal deficits, and seizures.**
- **Congenital involvement may be acute or chronic with seizures occurring in 1.1 to 7.9 %**



MRI: Eccentric target sign of toxoplasmosis

Toxoplasmosis and epilepsy *

- One-third of the global population carries a toxoplasma infection, then a huge number of people worldwide is probably at risk of developing toxoplasma-related epilepsy
- Good quality studies are needed to determine whether or not there is a risk/causal relationship between toxoplasmosis and epilepsy
- Based on current data, the risk of epilepsy with toxoplasmosis stands at 2.2-fold (CI 1.27 - 3.9)
- Many unanswered issues remain, including the role of different strains, epileptogenic mechanisms, etc.
- Combinations of parasites may have additive effects on consequential conditions such as toxoplasmosis and onchocerciasis on active convulsive epilepsy

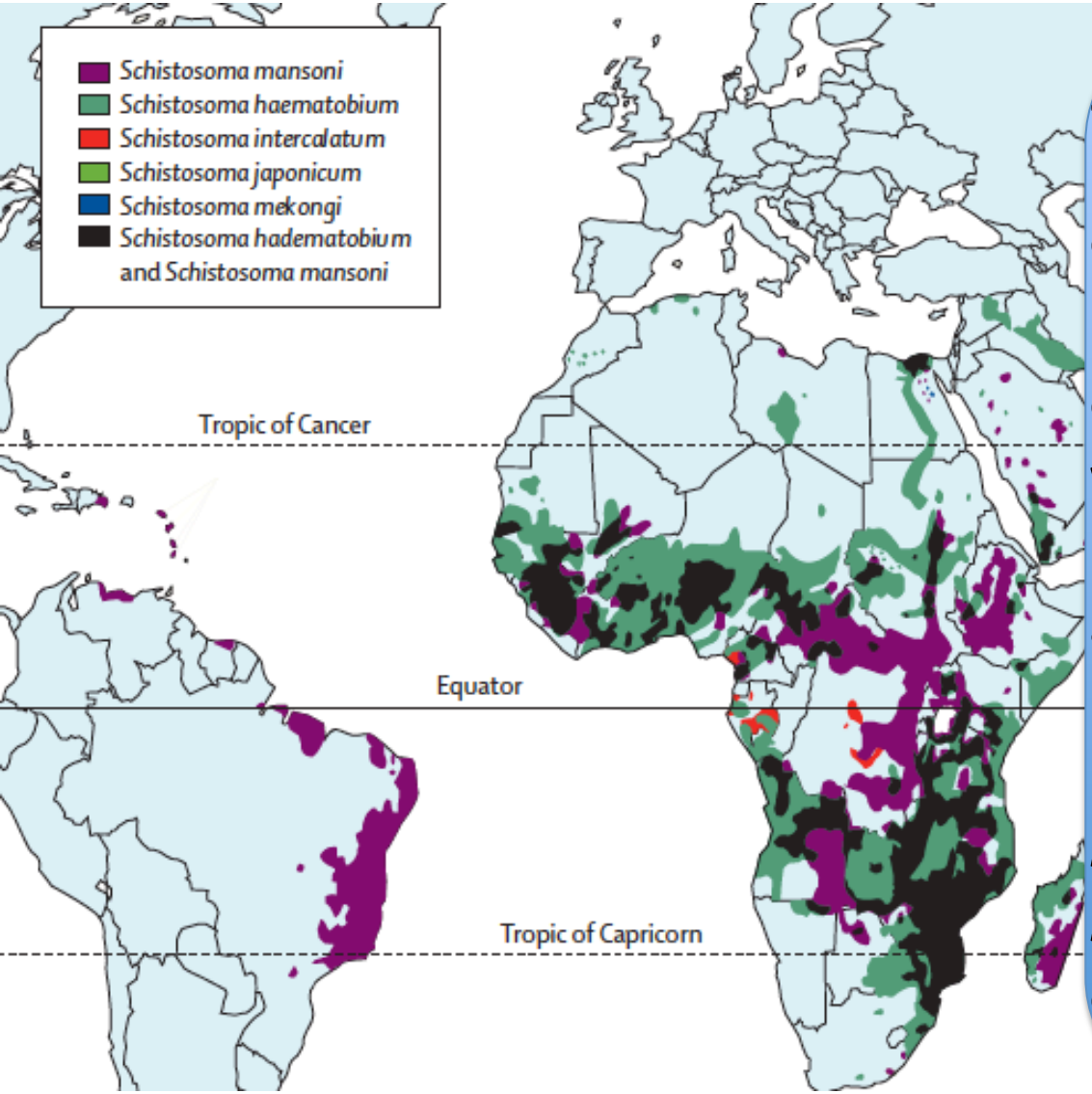
* Ngoungou EB, et al. Toxoplasmosis and epilepsy--systematic review and meta analysis. PLoS Negl Trop Dis. 2015 Feb 19;9(2)

Hydatidosis

- CNS infestation occurs in 2% of patients with echinococcosis.
- E. granulosus (Cystic E.) involve the liver and lungs but can be found in almost any tissue or organ, including the brain, and most characteristically as cystic masses.
- E. multilocularis (Alveolar E) frequently infects the liver but grows aberrantly as a membranous proliferating mass. It rarely metastasizes to the brain and commonly appears as a multicystic inflammatory mass

Abdel Razek AA, et al. Parasitic diseases of the central nervous system. Neuroimaging Clin N Am. 2011;21:815-41

Global distribution of schistosomiasis *



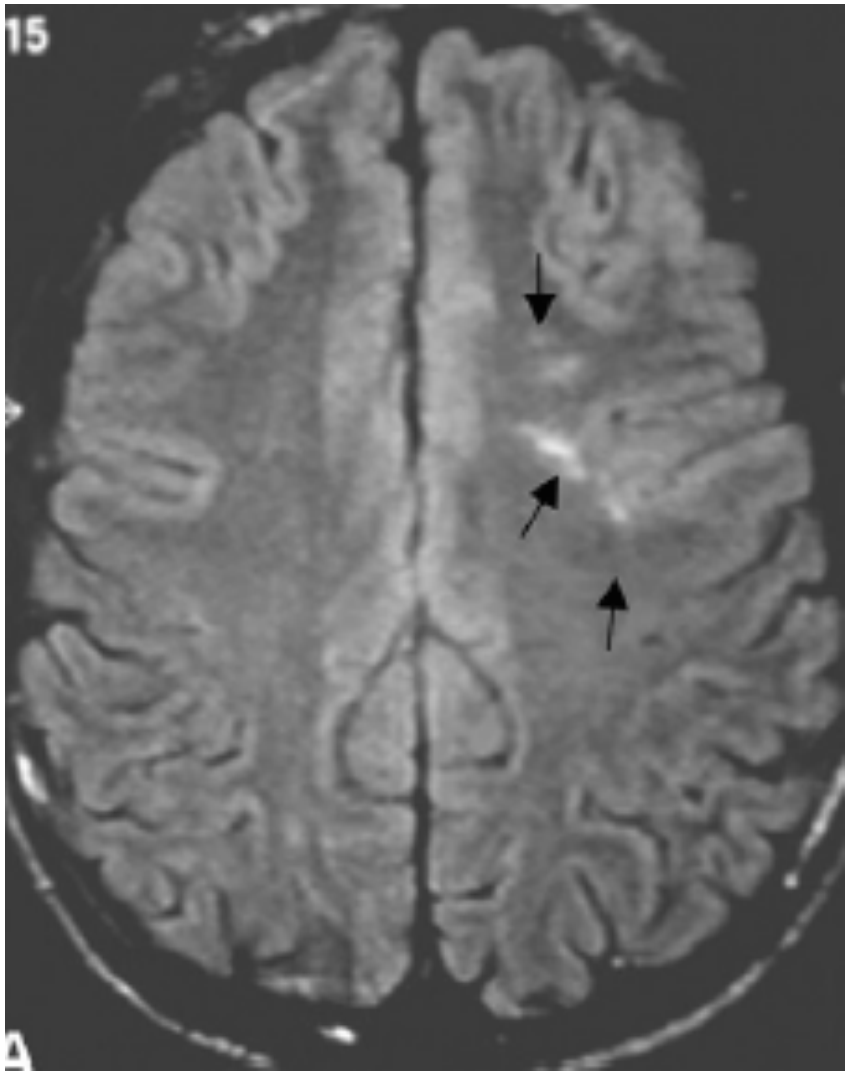
Schistosomiasis, a major infection of the tropics, is caused by trematodes.

Humans are infected after cerceriae—released into the water from freshwater snails—burrow through the skin and eventually find their way into the venules of the intestine (*S. japonicum, S. mansoni*) or urinary tract (*S. hematobium*) and deposit ova in the respective organs.

* Ferrari TC, Moreira PR. Neuroschistosomiasis: clinical symptoms and pathogenesis. Lancet Neurol. 2011 Sep;10(9):853-64.

Schistosomiasis

- CNS disease occurs due to inflammatory response to ova present in the brain through embolization or deposition by ectopic adult worms.
- Acute encephalitis, usually in the presence of a systemic illness with fever and eosinophilia, in about 2-3 % of cases of acute schistosomiasis.
- Chronically infected patients occasionally develop tumor-like granulomatous masses in the brain. Seizures are a frequent symptom.



* Coyle, CM Schistosomiasis of CNS Handb C Neurol, Vol. 114, 2013

Clinical presentations of neuroschistosomiasis according to the phase of schistosome infection *

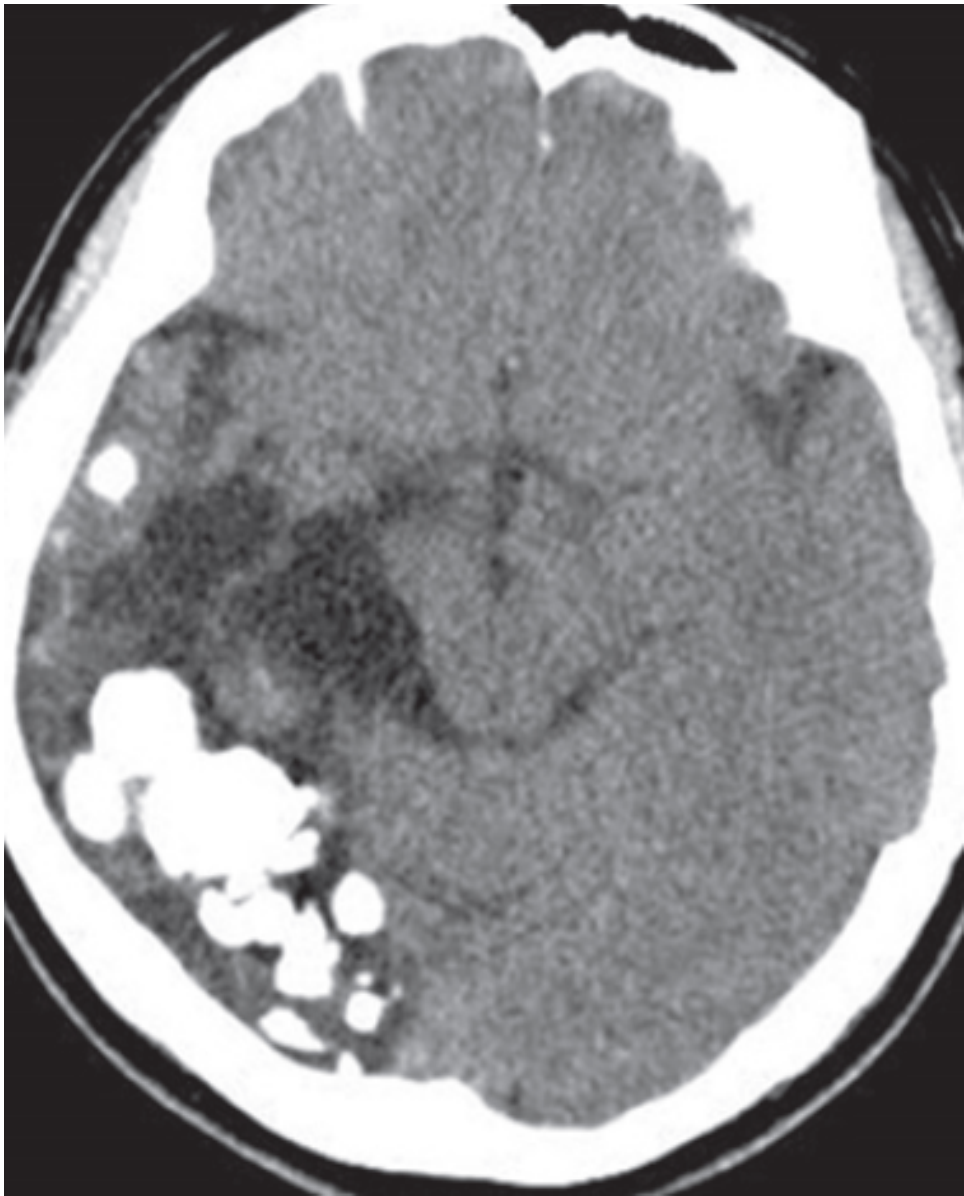
	Clinical forms of neuroschistosomiasis	Pathogenic mechanism of neuroschistosomiasis	Major infective species
Acute phase			
Symptomatic pre-egg-laying phase	Acute schistosomal encephalopathy	Immune-mediated*	*Schistosoma japonicum*
Acute toxaemic or Katayama syndrome	Acute schistosomal encephalopathy	Unclear: Vasculitis* Egg and granulomas* Other*	*S japonicum*
Chronic phase			
Intestinal Hepatointestinal Mild urinary	Tumoral encephalic schistosomiasis or spinal cord schistosomiasis	Eggs surrounded by granulomas in circumscribed areas of the CNS	*S japonicum* *Schistosoma mansoni* *Schistosoma haematobium*
Hepatosplenic Obstructive uropathy	Asymptomatic egg deposition in the CNS	Sparse distribution of the eggs and scanty granulomas	All species

*Mechanism has not yet been proven.

* Ferrari TC, Moreira PR. Neuroschistosomiasis: clinical symptoms and pathogenesis. Lancet Neurol. 2011 Sep;10(9):853-64.

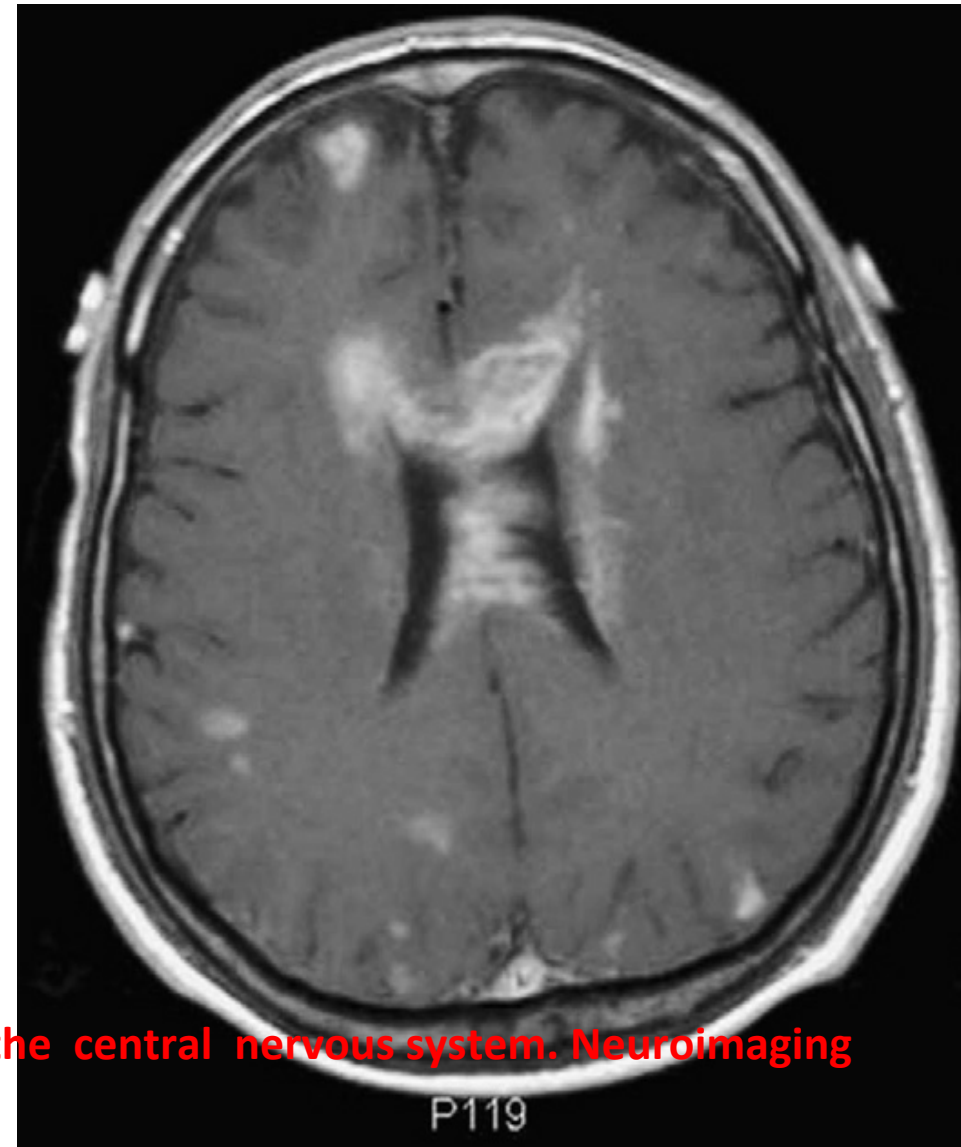
Paragonimiasis

- **Paragonimias is caused by ectopic migration of worms (P. westermani) to the brain or embolization of ova through blood vessels.**
- **Snails release cerceriae that then embed into the tissues of crabs or crayfish, where they develop into infectious metacerceriae.**
- **The wandering adult Paragonimus makes tunnels along the track of migration.**
- **“soap bubble calcifications” are characteristic of infection.**
- **Seizures are present in most patients, with focal deficits**



Chagas' Disease

- Infections with *Trypanosoma cruzi* usually occur after the bite of an infected reduviid bug.
- Meningoencephalitis occurs in children >2 years of age, and CNS manifestations are not a regular feature in chronic disease.
- Patients with chronic asymptomatic infection may recrudesce and develop meningoencephalitis, as a consequence of immunosuppression or AIDS.
- Seizures are a common manifestation



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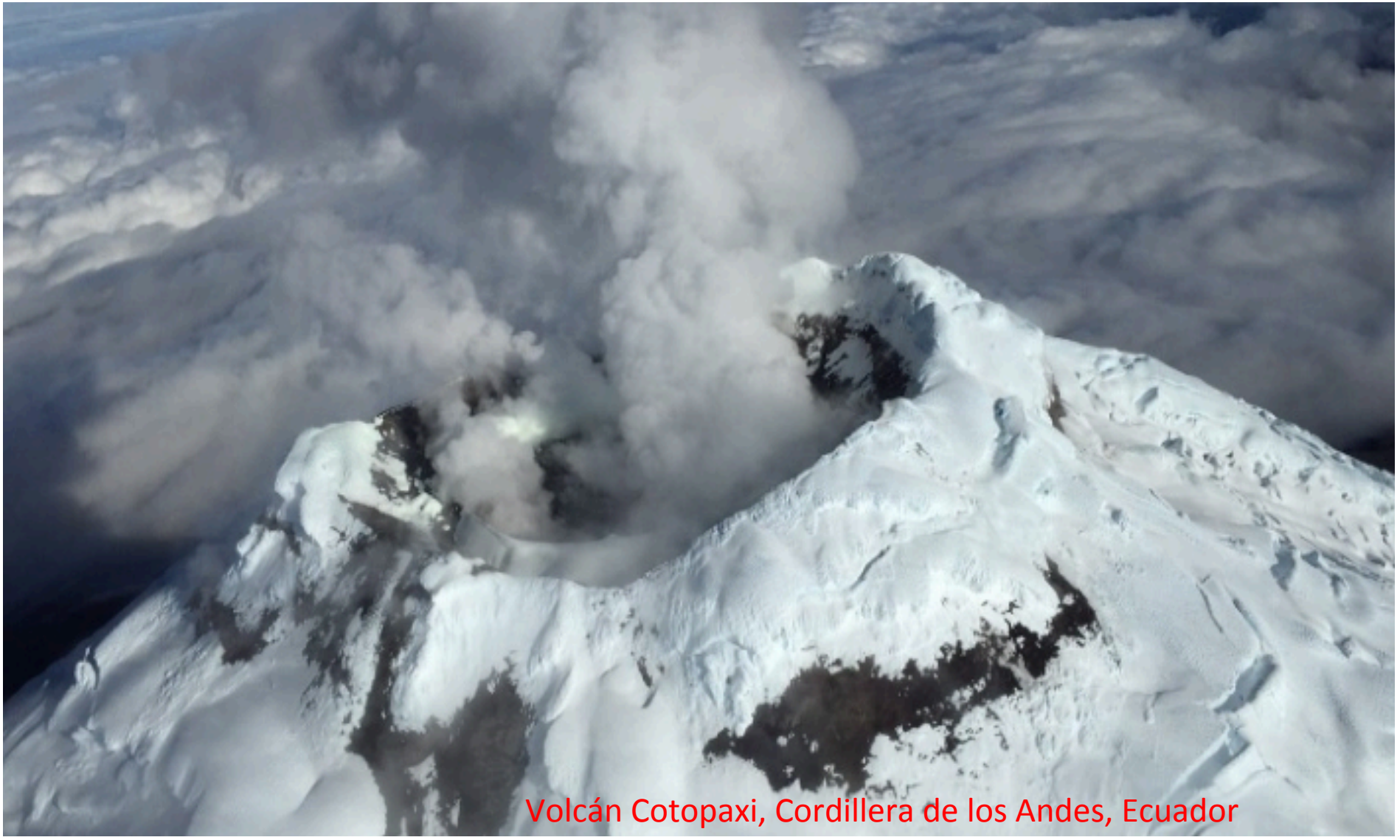
African Trypanosomiasis

- ***T. gambiense* and *T. rhodesiense* are transmitted by the tsetse fly and cause two usually distinct clinically syndromes of sleeping sicknes.**
- ***T. rhodesiense* is a normal parasite of urbivors in East Africa. People are accidently infected, resulting in an acute febrile illness. CNS involvement commonly occurs within weeks postinfection.**
- **The infection caused by *T. gambiense* affects predominately humans; the disease is usually insidious over months to years**

Toxocariasis

- **Ingestion of significant eggs of animal Ascaris species—most commonly Toxocara cati and Toxocara canis—give rise to systemic eosinophilic syndromes caused by larvae migrating through the tissues.**
- **Disease is caused by granulomatous inflammatory response to the larvae**
- **CNS involvement including death is uncommon but well described.**
- **Seizures have been described in from 6 to 51%.**

Gracias



Volcán Cotopaxi, Cordillera de los Andes, Ecuador