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Neurocysticercosis

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Introduction

Neurocysticercosis (NCC) is one of the most common parasitic infections of the central nervous system in humans and is the most serious clinical manifestation of cysticercosis. NCC is caused by the ingestion of the larval form of the pork tapeworm *Taenia solium.* NCC is endemic in low income developing countries where pigs are commonly raised, including the countries of Central America, South America, and parts of Africa and Asia. (Naddaf, Seeger, & Stafstrom, 2014).

The parasite *Taenia solium* encysts in the brain and can express a broad range of symptoms including seizures, headache, hydrocephalus, encephalitis, stroke and mental health and cognitive disorders. Neurocysticercosis is a leading cause of acquired epilepsy in epidemic regions with 25%-40% affected individuals showing evidence of the parasitic infection. This infection process is usually diagnosed due the development of new-onset seizure disorder in an individual (O'Neal & Flecker, 2015).

Over the past two decades, medical advancements such as diagnostic testing, anti-parasitic drugs, anti-inflammatories, and neurosurgical procedures have improved the prognosis of patients infected with *Taenia solium.* However, despite these advancements NCC has remained a major public health problem in most of the world. Millions of individuals are estimated to be infected with this parasitic infection, many becoming symptomatic at some point in their lives. Aggressive management of this infection is needed to combat mortality from extraparenchymal neurocysticercosis mainly due to intracranial hypertension, but effective treatment is not always available in endemic regions (Garcia, Nash, & Del Brutto, 2014).

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Pathophysiological Processes

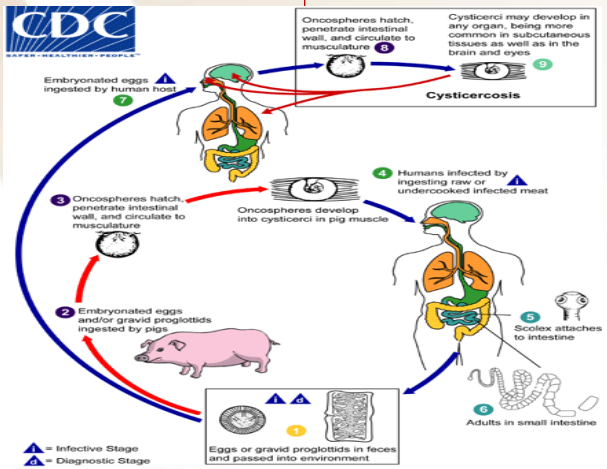
Neurocysticercosis occurs when the encysted larval forms of Taenia solium invade the central nervous system of a host. Taenia solium also known as the "pork tapeworm" is one of the eight cestode species that can infect humans. Humans are the definitive host and harbor the adult parasite while omnivorous and herbivorous animals such as pigs are the intermediate host and harbor the larval forms of the parasite. The adult parasite rarely causes harm to the human host and usually resides in the lower digestive tract of the individual. Here it absorbs nutrients from the small intestine because the parasite lacks its own digestive track. However the larval form of the parasite which are contained in fluid filled sacs (cysticerci) can cause significant degrees of illness if tissue invasion occurs (Nwakudu & Ekechukwu, 2013).

Two major pathways leading to the disease transmission of NCC exist: 1) The infestation of humans via contaminated environmental media or food 2) The infestation of swine caused by the direct ingestion of human feces, contaminated soil, food or water containing the parasitic embryos. Autoinfection after ingestion of eggs by the tapeworm-carrying host, via fecal-oral transmission can also be a potential exposure pathway (Enander, Ramirez, Enander, & Gute, 2010).

An example of the life cycle of the parasite begins when the human host excretes the parasite's eggs through feces. The eggs are then consumed by an omnivore such as a pig. The eggs hatch into larval form in the alimentary tract of the pig and begin to invade the tissue. The larval form is then ingested by humans after the consumption of undercooked meat. The lifecycle of the parasite is then completed after the encysted larvae is freed in the stomach by gastric acid and bile salts (Nwakudu & Ekechukwu, 2013).

Once the tapeworm embryo is freed from its protective envelop, it is able to freely penetrate the wall of the gut and travel into systemic circulation. The embryos are displaced throughout the body while traveling the venous system and may invade multiple areas of the host including the bowel walls, heart, skeletal muscles, eyes and other critical areas such as the central nervous system including the brain and spinal cord. The larvae can invade areas of the brain such as the ventricles and subarachnoid space, lying dormant in an encysted form within the host for years (Nwakudu & Ekechukwu, 2013).

Below: Lifecycle of pork tapeworm, Taenia solium. Copyright 2014 by CDC



Case Study: Neurocysticercosis in Wisconsin

Reported cases of Neurocysticercosis are increasing in the United States, especially among immigrants who previously lived in endemic areas and individuals living in the southwestern border states. Here are three separate cases that presented to and were evaluated at the same institution in Wisconsin. (Naddaf, Seeger, & Stafstrom, 2014).

Patient 1

A 25-year old woman who presented with three focal seizures. She recently moved to Wisconsin from the Philippines 2 months prior to symptom presentation. There were no focal neurological deficits on examination. An MRI showed a 6mm ring-enhancing lesion located in the right frontal lobe. An Electroencephalography (EEG) and serum and cerebrospinal fluid cysticercosis IgG's were negative. Diagnosis of Neurocysticercosis (NCC) was suspected. The patient was treated with dexamethasone for 15 days, followed by albendazole for 15 days. For seizure prophylaxis she was started on levetiracetam. Two years later patient did exhibit right lip twitching after mission a dose of levetiracetam, otherwise the patient has remained healthy and seizure free. However MRI follow-up was not obtained due to lack of insurance coverage (Naddaf et al., 2014).

Patient 2

A 38 women history of left face, arm and leg dysesthesias and generalized tonic clonic seizure. Patient had moved from Mexico 14 years prior. Examination showed decreased sharp perception on the left limbs and increased pain response to hot and cold temperatures. MRI showed 16 x 8 mm ring enhancing in the right frontal parietal area. Due to high suspicion of tumor two brain biopsies were performed, one showing normal brain tissue and second showing inflammatory infiltrates with lymphocytes and eosinophils, with NCC being suspected. Patient was started on prednisone and a 30 day regiment of albendazole. Prescribed gabapentin controlled the dysesthesias and seizures were controlled by lamotrigine 4 years after initial presentation. Follow-up MRI showed decreased size of the brain lesion (Naddaf et al., 2014).

Patient 3

A 23 year old women complaining of left arm dysesthesias and numbness, with radiation into left neck and face. Symptoms also included difficulty speaking, hearing, and dull headaches for the past year. She had admitted to traveling to Mexico several times within the past 2 years. Brain MRI showed 9 x 12mm ring enhancing lesion in the right parietal lobe. Cysticercosis serum IgG was 0.61 and considered positive. The patient was treated with prednisone and a 10-day course of albendazole. Levetiracetam was prescribed for seizure prophylaxis. Patient reports being healthy and doing well 8 years after initial presentation (Naddaf et al., 2014).

Image: Center is an image of a Taenia egg at a high magnification of 400x. When consumed by humans Taenia eggs can lead to cysticercosis, including a serious condition known as neurocysticercosis. On the left and right are radiographic images of humans with neurocysticercosis. The darker regions are cysts in the brain of the patient.. Copyright 2014 by CDC.

Signs and Symptoms

The clinical presentation and severity of the disease process is diverse and can present with a myriad of manifestations. Signs and symptoms can vary depending on the size, location, development of the cysterci and the host's immunological response to the parasite. The most common clinical manifestation is epilepsy and occurs in 70% of infected patients. Psychiatric symptoms and cognitive status changes including delusions, hallucinations and catatonia are frequent clinical presentations in patients infected with NCC and may cause a delay in diagnosis (Shah & Chakrabarti, 2013). Additional symptoms from the invading larvae on the central nervous system include: headaches, hydrocephalus, nausea, blurred vision, vertigo, and ataxia. (Enander, Ramirez, Amaya, Enander & Gute, 2010). Most symptoms are caused by either the inflammatory response of the host or mass effect and symptomology can be greatly affected by the location and size of the cyst as well as the amount of cysts affecting the host (Cantey et al., 2014).

Nursing Implications

Implications for nursing care can be incorporated into several aspects of the disease process. Due to the diverse clinical manifestations of neurocysticercosis (NCC), importance is placed on correct identification of signs and symptoms and vigilance in recognizing common symptoms of NCC that may parallel other psychiatric diseases and lead to misdiagnosis (Shah & Chakrabarti, 2013).

Health care workers also need to remain attentive to reporting potential or confirmed cases to the appropriate health care agency. Historically NCC has previously been believed to mainly affect the immigrant population. However growing case reports have suggested the transmission of this disease here within the United States. Even with the increased awareness of this disease, under-reporting of essential data and confirmed cases is lacking (Cantey et al., 2014).

Nursing assistance and education on the compliancy of treatment including medications and repeated medical evaluation and diagnostic scans will remain important in combatting this disease especially in underdeveloped and impoverished areas. Educating the public on the disease, including transmission pathways and reduction, symptoms and when and where to seek help for treatment are all implications of nursing care.

Conclusion

Neurocysticercosis results from the invasion of the central nervous system of a human host by the larvae of the adult tapeworm, Taenia Solium. While this disease has been uncommon in the United States prior to 1965, new cases are emerging at an unprecedented rate due to immigration, with an estimated 1,000 new cases occurring in the United States annually with a substantial amount of cases occurring in the southern states bordering Mexico (Enander et al., 2010). While world eradication of this disease is unlikely, close attention is warranted to identify populations at risk. The development and implementation of risk reduction interventions in these vulnerable populations is of utmost importance to assist with the elimination of disease transmission. Emphasis should be placed on the adoption of effective preventative measures by health care agencies, international travelers/workers and individuals living in endemic areas.

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