



Control of neurocysticercosis

Report by the Secretariat

BACKGROUND

1. Cysticercosis of the central nervous system (neurocysticercosis) is caused by the larval stage (cysticerci) of the pork tapeworm *Taenia solium*. The two-host life cycle of this tapeworm comprises human beings as definitive hosts and swine as intermediate hosts. Pigs become infected when they ingest human faeces containing *T. solium* eggs, which develop in the muscle and brain into cysticerci. When people eat undercooked pork containing viable cysticerci, they develop an intestinal tapeworm infection, but not cysticercosis of the central nervous system. Human beings can also become intermediate hosts, however, by directly ingesting *T. solium* eggs shed in the faeces of human carriers of the parasite. These eggs then develop into cysticerci which migrate mostly into muscle (causing cysticercosis) and into the central nervous system where the cysticerci can cause seizures and many other neurological symptoms (cysticercosis of the central nervous system). Both forms of human cysticercosis are therefore human-to-human infections acquired by the faeco-oral route in areas with poor hygiene and sanitation. Such a route of transmission is strongly supported by the concentration of cases of cysticercosis of the central nervous system in communities with human carriers of *Taenia*, which clustering also supports the argument that carriers of *Taenia* are potent sources of contagion.

2. Cysticercosis of the central nervous system is the most important neurological disease of parasitic origin in humans. It causes serious morbidity and in areas where *T. solium* is endemic, is known to be a leading cause of epilepsy, which has profound social, physical and psychological consequences. A study in Southern India reported in 2000 found an association between cysticercosis of the central nervous system and localization-related symptomatic epilepsies in 51% of patients. Conversely, a study in Honduras reported in 1999 showed that when a diagnosis of cysticercosis of the central nervous system had been made, seizures were the presenting symptom in 52% of cases. The diagnosis of cysticercosis of the central nervous system involves the interpretation of non-specific clinical manifestations, such as seizures, often with characteristic findings on computed tomography or magnetic resonance imaging of the brain, and the use of specific serological tests. Diagnostic criteria based on objective clinical, imaging, immunological and epidemiological data have been proposed for different levels of the health care system, but are not generally used in areas endemic for the disease. Lack of awareness by the medical community and differences in quality and availability of medical services mean a lack of comprehensive and consistent reporting, and thus substantial underreporting. In non-endemic industrialized countries imported cases have been found in, for example, carriers of intestinal-stage *T. solium* infection, who, through food-handling and other modes of contact, can be sources of locally-acquired cases, and persons with latent cysticercosis of the central nervous system. Human carriers of *T. solium* can routinely be diagnosed by the detection of proglottids or eggs in

faeces, or by more sensitive methods such as the detection of *Taenia* antigens in stools or specific antibodies in serum.

3. Human cysticercosis is a disease associated with poverty in areas where people eat pork and traditional pig husbandry is practised. It is endemic in the Andean area of South America, Brazil, Central America and Mexico; China, the Indian subcontinent and South-East Asia; and sub-Saharan Africa (see Annex). The spread of the disease is facilitated by poor hygiene, inadequate sanitation and the use of untreated or partially treated wastewater in agriculture.

4. Cysticercosis of the central nervous system is an important cause of chronic epilepsy, which places particular demands on the health services. When cysticercosis is associated with epilepsy, the burden of disease will dramatically increase owing to the social stigmatization and discrimination surrounding the latter. This stigmatization may be a barrier to providing adequate diagnosis and treatment.

MEASURES CURRENTLY AVAILABLE TO CONTROL CYSTICERCOSIS

5. To control cysticercosis, the following measures are available:

- **Case management, reporting and surveillance.** Clinically, people with cysticercosis of the central nervous system usually present with non-specific neurological symptoms such as epilepsy, for which adequate case management should be available in health services. Such management requires a consensus on standardized criteria and guidelines for early differential diagnosis in peripheral health care structures, with emphasis on resource-poor areas as well as for possible treatment or referral to the next level of the health care system. Better surveillance and reporting will lead to a more accurate understanding of the extent of the problem and to the identification of foci of transmission.
- **Identification and treatment of individuals who are direct sources of contagion** (human carriers of adult tapeworm) and their close contacts, combined with **hygiene education and better sanitation**, will interrupt or reduce the cycle of direct person-to-person transmission, an approach that has been successfully applied to other contagious diseases.
- **Universal or selected treatment** with praziquantel (10 mg/kg body weight) has significantly reduced the prevalence of human taeniasis¹ in areas where *T. solium* infection is endemic, such as in Mexico. In order to limit reinfection of humans by the intermediate hosts, treatment needs to be accompanied by **veterinary sanitary measures** such as enforced meat inspection and control, improvement of pig husbandry and inspection, and treatment of infected animals. Single-dose therapeutic agents, for example oxfendazole, have recently become available and appear to be effective, with no deleterious effects on animals or on the meat product. Animal vaccines are under development.
- Long-term success is more likely when anthelmintic chemotherapy programmes are integrated into a wider **intersectoral approach** to increase public awareness and hygiene practices; additional measures to sustain the impact of specific interventions include the

¹ Praziquantel in a dose greater than 10 mg/kg body weight may have an effect against cysticerci, but may also increase peri-cysticercal inflammation. In cases where cysticerci have been located in the central nervous system, neurological symptoms have been reported after treatment with praziquantel at doses exceeding 10 mg/kg.

provision of clean water and sanitation, and health education about parasite transmission and ways to improve hygienic behaviour and sanitary conditions of humans and animals. A comprehensive improvement in living conditions, appropriate legislation, modernization of swine husbandry, and improvement in efficiency and coverage of meat inspection, have reduced transmission in many industrialized countries.

RESPONSES AND WHO ACTIVITIES

6. In 1993, the International Task Force for Disease Eradication declared *Taenia solium* a potentially eradicable parasite, for the following reasons: (i) the life cycle requires humans as definitive hosts; (ii) tapeworm infections in humans are the only source of infection for pigs, the natural intermediate host; (iii) the transmission of infection from pigs to human beings can be controlled; (iv) no reservoir for infection exists in wildlife. It is therefore expected that the strategic use of anthelmintics against the adult parasite in people and the larval parasite in swine, combined with health education and regulation of pig slaughter, is sufficient to interrupt transmission, but this approach has yet to be proven in practice.

7. Taeniasis and cysticercosis do not lead to sudden large-scale international outbreaks of disease and therefore would not seem to constitute an appropriate subject for international notification. Nevertheless, health ministries should be strongly encouraged to set up national surveillance and reporting systems, and adopt a more active approach towards prevention and control of these diseases. As a step towards promoting the control of human cysticercosis, particularly as a preventable cause of epilepsy, WHO will invite experts to an informal consultation with the aim of reaching consensus on crucial elements such as clinical diagnosis in resource-poor settings, surveillance and reporting methods, and cost-effective and sustainable intervention strategies. The successful outcome of the application of these elements should vindicate the control approach and lead to the elimination of disease.

8. Enhanced control of human cysticercosis and cysticercosis of the central nervous system will contribute to several international initiatives such as WHO's Global Campaign against Epilepsy – "Out of the Shadows", the scaling up of the response to diseases of poverty, the Food Safety Programme and the recently launched Partnership for Parasite Control.

ACTION BY THE HEALTH ASSEMBLY

9. The Health Assembly is invited to note the report.

ANNEX

AREAS WHERE CYSTICERCOSIS IS ENDEMIC



The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of WHO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dashed lines represent approximate border lines for which there may not yet be full agreement.