

Present Situation and Problems of Cysticercosis in Animal in Bali and Papua

(*PERMASALAHAN DAN SITUASI TERKINI TENTANG SISTISERKOSIS
PADA HEWAN DI BALI DAN PAPUA*)

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ABSTRAK

Sistiserkosis adalah zoonosis parasit disebabkan oleh larva *Taenia solium* dan merupakan masalah kesehatan masyarakat yang penting. Manusia terinfeksi sistiserkosis akibat menelan telur cacing *Taeniasolium*, biasanya terjadi di wilayah yang belum mengoptimalkan penggunaan jamban. Manusia dapat bertindak sebagai inang antara yang aksidental, sementara babi adalah inang antara yang normal. Secara klinis sistiserkosis menjadi masalah amat serius, ketika kista menyerang sistem saraf pusat atau mata. Kista dapat menetap di tempat tersebut selama beberapa bulan sampai beberapa tahun. Sistiserkosis ditemukan di seluruh dunia, terutama di negara-negara berkembang dimana masyarakatnya banyak mengkonsumsi daging babi serta sanitasi buruk yang memungkinkan mudahnya akses babi ke kotoran manusia. Penyakit ini diperkirakan akan terus meningkat, seiring dengan meningkatnya permintaan daging babi dari negara-negara tersebut. Sistiserkosis di Indonesia masih merupakan masalah kesehatan yang sangat penting, terutama di Bali dan Papua. Mayoritas masyarakat di Bali dan Papua beragama Hindu dan Protestan/Katolik, sehingga di daerah tersebut daging babi banyak dikonsumsi. Telaah singkat berikut merangkum problem dan situasi terkini mengenai sistiserkosis pada hewan di Bali dan Papua. Data epidemiologi dari penyakit ini diperoleh dari berbagai sumber.

Kata-kata kunci: sistiserkosis, hewan, Bali, Papua

ABSTRACT

Cysticercosis zoonotic parasitic disease caused by *Taenia solium* larva, is a major public health problem. Cysticercosis results from the development of larval tapeworms in humans harboring adult *T. solium* or from ingesting soil containing eggs shed in the feces of humans, in areas where there are no latrines. Humans are accidental intermediate hosts and pigs are the normal intermediate hosts. Clinically they are most serious when located in the central nervous system or in the eye where they persist for months to years. Cysticercosis occurs worldwide primarily in developing country where pigs are raised, pork consumed and poor sanitation allows pigs' access to human faeces. The occurrence of the diseases is expected to increase in relation to the growing demand for pork in those countries. In Indonesia cysticercosis is still a very important health problem, especially in Bali and Papua. The majority of the populations in Bali and Papua are Hindus and Protestants/Catholics, respectively, so pork widely consumed in those islands. This brief review summarizes the present situation and problems of cysticercosis in animal in Bali and Papua. Epidemiological data of the diseases were obtained from several sources.

Keywords: cysticercosis, animal, Bali, Papua

INTRODUCTION

Cysticercosis is an important parasitic zoonosis in developing countries caused by the larva of pork tapeworm *Taenia solium*. It requires human and pig as hosts to maintain its life cycle. Man can act as both definitive and intermediate host of the parasite. The adult form of the parasite found in the human's intestine is commonly not harmful and produces non-specific symptoms. However, the cysticerci that infest central nervous system, eye, subcutaneous tissue, and skeletal muscles produce symptoms associated to the organs affected (Juyal *et al.*, 2008; Prasad *et al.*, 2008).

Cysticercosis is emerging as a serious public health and agricultural problem in many under privileged countries (Willingham and Engels, 2006). The larval cysts can cause epilepsy or even death in humans. Meanwhile, the larval cysts in pigs can reduce the market value of pork as well as make it unsafe to eat. This zoonotic disease occurs in places where pigs roam freely, with poor sanitation, and where meat inspection is absent or inadequate (Flisser *et al.*, 2006; Willingham and Engels, 2006; Prasad *et al.*, 2008). People who neither raise pigs nor consume pork are also at risk of cysticercosis if they ingest *T. solium* eggs after coming into direct or indirect contact with tapeworm carriers (Schantz *et al.*, 1992; Ito *et al.*, 2002; 2004; Al Shahrani *et al.*, 2003; Rajshekhar *et al.*, 2003; Hira *et al.*, 2004; Willingham *et al.*, 2003; Willingham and Engels, 2006). Some scientists have reported that cysticercosis is strongly associated with poverty and smallholder farming (Pawlowski *et al.*, 2005; Flisser *et al.*, 2006; Willingham *et al.*, 2010).

Cysticercosis/taeniasis is still a very important health problem in Indonesia. Although most Indonesian people are Muslim and do not eat pork, infection with *T. solium* has occurred in some areas or islands where most local people are Christian or Hindu (Wandra *et al.*, 2003). Taeniasis in this country is caused by three tapeworms, namely *T. solium*, *T. saginata* and *T. asiatica* (Ito *et al.*, 2004; Margono *et al.*, 2006). The tapeworms have been reported from three endemic cysticercosis/taeniasis areas: Bali (*T. solium* and *T. saginata*), Papua (*T. solium*) and North Sumatra (*T. asiatica*). The prevalence of the disease in humans in Indonesia ranges between 1.1% - 45.8% (Suweta, 1991; Rajshekhar *et al.*, 2003; Margono *et al.*, 2006, Suroso *et al.*, 2006; Wandra *et al.*, 2006a; 2006b). In contrast,

reports of cysticercosis incidence in animals (pigs and cattle) in Indonesia are very rare. The following review is a brief account on the current situation and problems of cysticercosis in pigs and cattle in Bali and Papau.

SITUATION AND PROBLEMS OF ANIMAL CYSTICERCOSIS IN BALI

Bali is a small island of 153 km length and 112 km width. Geographically it lies between latitude 8°03'40"-8°50'48" S and longitude 114°25'53"-115°42'40" E that makes it to have a tropical climate like the other parts of Indonesia. Bali has an area of 5636.6 km², approximately 0.3% of the whole region of Indonesia. In 2010, its population reached 3,891,428 people with an average population density of 690 per km², with most population inhabiting the southern part of the island making the density in this part about double the average density. The majority of the populations are Hindus (92.3%), so pork is widely consumed in this island. In 2009, the populations of pigs and cattle in Bali were 945,186 and 688,503, respectively (Direktorat Jenderal Peternakan, 2011a; 2011b).

In contrast to the situation of 2-3 decades ago, nowadays cysticercosis in both pigs and cattle in Bali is rarely reported. This does not mean that the cases do not exist, since the prevalence of humans taeniasis in Bali is always reported. According to Wandra *et al.* (2007) in a recent survey on human taeniasis and cysticercosis in four districts in Bali (Gianyar, Badung, Denpasar, Karangasem) in 2002 to 2005, of 540 local people surveyed, the prevalence rate of *T. saginata* taeniasis was found in the range of 1.1% to 27.5%. Prevalence of *T. saginata* taeniasis has increased dramatically in Gianyar, as shown by the prevalence in 2002 (25.6%) and in 2005 (23.8%), as compared to previous survey in 1977 (2.1%) and 1999 (1.3%), respectively (Simanjuntak *et al.* 1977; Sutisna *et al.* 2000). It is possibly due to the increase in the number of families who consume raw beef (beef lawar) (Wandra *et al.* 2006a; 2007). Lawar is a traditional Balinese food made of minced raw pork or beef mixed with grated coconut and spices (Suweta, 1991; Juyal *et al.*, 2008).

Unlike taeniasis cases, *T. solium* cysticercosis in humans in Bali is now rather rare as compared to 1-2 decades ago (Suroso *et al.*, 2006; Sudewi *et al.*, 2008). According to Juyal *et al.*, (2008) a 21% prevalence of anticysticercus antibodies in sera based on

ELISA among inhabitants of Bali was reported by Coker-Vann *et al.* (1981) and an immunoblot-based seropositivity of 13% was found by Theis *et al.* (1994). Sutisna *et al.* (1999) reported that seroprevalence of human cysticercosis in Bali by immunoblot was 1.65% (6/363), out of 363 samples collected from three villages namely Pamesan and Batuaji in Gianyar district and Penarukan in Tabanan district. Wandra *et al.* (2007) also reported that among 596 local people studied in five villages in 4 districts of Bali in 2002-2006, there was no indication of *T. solium* taeniasis as well as history of epileptic seizures and subcutaneous nodules except for 2 seropositive cases out of 451 samples, including 0.8% (1/125) in Gianyar in 2002, and 2.8% (1/36) in Karangasem in 2006, respectively.

Reports on the distribution of cysticercosis in pigs and cattle in the world, including Indonesia are scarce. In general, data on cysticercosis in animals were based on meat inspection according to the local situation where it is carried out only superficially or even no attention given at all, so cases might be misdiagnosed or in general under-reported (Margono *et al.*, 2005; Suroso *et al.*, 2006). Report of cysticercosis in animals will be available if specifically programmed surveillance or researches are carried out. The absence of data on cysticercosis in pigs and cattle for the last twenty-five years may be due in part to the fact that the government has not paid enough attention and that there is lack of surveillance

Table 1. Cysticercosis in pigs in Bali during the years 1975-1988

Year	Number examined	Number positive
1975	20,148	59
1976	40,136	201
1977	31,706	86
1978	30,988	181
1979	31,187	305
1980	15,356	90
1981	49,126	60
1982	69,054	69
1983	106,442	41
1984	122,802	23
1985	157,585	91
1986	75,932	2
1987	148,207	-
1988	149,112	-

Source: Margono *et al.* (2005)

or research activities done to reveal cases. According to the Bali Livestock Office, there are many zoonotic diseases given priority by the government including avian influenza/bird flu and rabies. According to Margono *et al.*, (2005), in the year 1977 a report of the Directorate Animal Health, Directorate General of Livestock Service, Department of Agriculture mentioned that the prevalences of cysticercosis in cattle in 4 districts of Bali namely Badung, Gianyar, Klungkung, and Tabanan are as follows: 3.3%, 16.9%, 1.2% and 8.3%, respectively. In the same year the prevalences of cysticercosis in pigs in two districts of Bali, Badung and Klungkung, were 2.1 and 10.5%, respectively. In the year 1989 the Livestock Services Unit Denpasar, Bali reported cases of cysticercosis of pigs in Bali during 1975-1988 (Table 1). In addition, Dharmawan *et al.*, (1992) reported cases of *T. solium* cysticercosis that were found in pigs in Bali in 1990. Seven of the 5630 pigs (0.12%) examined in Denpasar Slaughterhouse were found heavily infected with *T. solium* cysticerci.

Host-parasite relationship of *T. saginata* in Bali was studied by infecting two cattle, each with 30 human derived proglottids of *T. saginata* (Dharmawan, 2000). The adult worms obtained from feces of treated patients were cleaned with pipe water and taken to the laboratory for identification by pressing the gravid proglottids between two object glasses and counting the uterine branches. The two 5-month-old female cattle were negative for Taenia. Gravid proglottids were mixed with physiological saline solution and administrated orally to both cattle. Cattle 1 and 2 were slaughtered and examined for the presence of *T. saginata* cysticercus at six- and eight weeks post infection, respectively. Cysticerci were found in the masseter muscle and the caudal femur of cattle 1 whereas in cattle 2 an abundant number of cysts were widely distributed in almost all skeletal muscles, namely in muscles of the cheek, intercostal muscles, diaphragm, heart and thighs. In each slice of the muscles were found 3 to 5 cysts. The cysticerci in cattle 1 were less developed (size about 3 mm x 2 mm) in comparison with those found in cattle 2 (size about 4 mm x 3 mm). Therefore, it was concluded that the optimal development time of cysticerci was at least eight weeks after infection (Dharmawan, 2000). Similar experiment was done ten years later to observe the development, distribution, and infection density of *T. saginata* cysticercus in Bali cattle (Dharmawan *et al.*, 2009). Three Bali

cattle were experimentally infected with *T. saginata* eggs which were collected from taeniasis patients in Bali. To observe the development of cysticerci, all cattle were slaughtered at 24 weeks post infection. The study results showed that cysts were found distributed in all muscle tissues and some visceral organs such as heart, diaphragm, lungs, and kidneys of the cattle. Density of the cyst was in the range of 11 to 95 cysts per 100 grams of tissue. The highest density was noted in the heart (58/100 grams) and diaphragm (55/100 grams). From this study it was concluded that it is necessary to include the heart in the meat inspection at slaughter house for possibility of *T. saginata* cyst infection (Dharmawan *et al.*, 2009).

The important issues or problems related to cysticercosis/taeniasis in Bali are: 1) There is no reported incidence of cysticercosis in pigs and cattle during the last three decades, so the prevalence and distribution of data is very necessary to formulate the control strategies of cysticercosis in Bali, 2) Although the majority of the population in Bali are Hindu, they consume beef, and thus can be infected with *T. saginata*; 3) Previous surveys showed that local people consumed pork more frequently, but *T. saginata* taeniasis was more common; 4) Incidence of *T. saginata* taeniasis in Gianyar regency are reported almost every year, although anthelmintic treatment have been given, and awareness generating education has been carried out to the local people; 5) Nowadays education to build awareness of cysticercosis/taeniasis in some regions in Bali is not done anymore.

SITUATION AND PROBLEMS OF ANIMAL CYSTICERCOSIS IN PAPUA

The Papua (New Guinea) island is the second largest island in the world after Greenland, located north of Australia. The island is divided into two regions: western region (West New Guinea), controlled by Indonesia and the eastern (East New Guinea) that constitutes the country of Papua New Guinea. Western New Guinea which belongs to Indonesia comprise of two provinces namely Papua Province and West Papua Province.

Papua is the largest province of Indonesia. This province has an area of 309,934.4 km², approximately 16.5% of all parts of Indonesia. Geographically it lies between latitude 9°20'-0°10' S and longitude 134°10'-141°10' E. To the east is the State of Papua New Guinea or East New Guinea. Compared to its large area, its

population is not too many; in 2010 it has a population of only 2,851,999 people, with a population density of 9 per km². The majority of the populations are Protestants and Catholics (76.6%). Just like in Bali, people in Papua have no restriction to eat pork. Even pigs in Papua are in very close relationship with the owners. In 2009, the populations of pigs and cattle in Papua were 530,754 and 56,156 respectively (Direktorat Jenderal Peternakan, 2011a; 2011b).

The prevalence of *T. solium* cysticercosis in pigs in Papua is estimated to be the highest in Indonesia, around 65% (Putra, 2011 personal communication). This estimate was made based on the fact that it is not difficult to find cysticercosis in pigs in the field. The exact data are rarely reported since there is no good record and no implementation of surveillance and/or research undertaken in a systematic and sustained manner on the cases. Surveillance and/or new research carried out if there is a special project for the purpose. However, results of previous studies revealed that prevalence of *T. solium* cysticercosis in pigs in Papua is high. Even the prevalence has been one of the highest reported in the world (Juyal *et al.*, 2008).

Margono *et al.* (2005) reported fifteen pigs with cysticercosis from nine villages during August and September 1998. A serological survey in 11 villages from Jayawijaya revealed 17 (8.5%) positive immunoblot in 201 pig samples as shown in Table 2. Among 71 pigs of five villages (Kimbim, Wesaput, Araboda, Piramid and Woma) 21 were strongly immunoblot positive, 7 moderately and 23 weakly positive. Analysis of dog sera by both ELISA and immunoblot revealed that 7 of 64 dogs were highly positive. Necropsy of two sero-positive dogs found cysticerci of *T. solium* in the brain and heart. Another dog strongly suspected by ELISA and immunoblot was killed and found full of cysts in the brain, heart and muscles (Ito *et al.*, 2002; 2005; Margono *et al.*, 2006; Wandra *et al.*, 2007). In August 2010, we found a pig suspected infected *T. solium* cysticercus in Tenunggame Village, Sub-district Bolakme, Jayawijaya. The pig was approximately 5-6 months old with a body weight 25-30 kg was bought for necropsy. From the necropsy there were found cysticerci of *T. solium* in the heart and all muscles. In another word, the whole body and heart of the pig were so full with cysticerci that when the pig was being slaughtered cysticerci literally popped out from the tissues and mixed with the blood.

The prevalence of *T. solium* taeniasis/cysticercosis in humans in Papua is also high. In Papua, the first report of taeniasis/cysticercosis cases came from Paniai District (Suroso *et al.*, 2006). In Enarotali hospital, Paniai District, 9% of 170 hospitalized patients were stool positive for Taenia eggs. During 1972-1973 13 cysticercosis cases were reported and 77.3% of individuals with clinical signs of cysticercosis were serological positive. During 1973-1976 the number of cases of burns resulting from accidents during epileptic seizures increased to 257. Taeniasis/cysticercosis was found to be highly endemic around Wamena, Papua. During the years 1991-1995 a local health centre in Assologaima Sub-District reported 1120 new cases with burns and 293 new cases of cysticercosis-related epileptic seizures among 15,939 inhabitants. Recent surveys in 2000-2001 revealed that 5 of 58 local people (8.6%) harbored adult worm of *T. solium*, whereas 44 of 96 people (45.8%) were seropositive for cysticercosis (Margono *et al.*, 2005).

Based on some reports (Ito *et al.*, 2002; 2004; 2005; Wandera *et al.*, 2003; 2006a; 2007; Margono *et al.*, 2005; 2006; Suroso *et al.*, 2006) we can conclude that the most important issue or problem related to cysticercosis/taeniasis in Papua includes: 1) the population aged 18 years or older group, with low level of education and the habit of not washing hands before eating were the important factors associated with cysticercosis; 2) poor personal hygiene and environmental sanitation is generally prominent

in Papua; from a study conducted in four sub-districts of Jayawijaya, among 506 families in 1996-2005 showed only 17% (86/506) defecated in toilet, 64.6% in the garden, 10.3% in the forest, 6.3% in the backyard, and 1.8% in the river; 3) most of the local people do not cook the pork properly (cooking with hot stones is the traditional method), and they frequently eat raw sweet potatoes without washing before consuming; 4) pigs are raised without a confinement fence, thus pigs are allowed free so they get access to human faces.

The community of Papua, especially in Wamena treats pigs as very special animals. Pig is the main livestock as source of both protein and income. Almost every family in Wamena raises pigs. Generally, pigs are kept in the cage at night and released in the morning to forage. A pig cage is usually located very close to the Honai (meaning home). In Wamena people have a tradition of cooking food with hot stones, including cooking pork with tuber and sweet potatoes that are put in a hole or drum and cooked by using hot stones for less than 2 hours (Ketaren, 2008). Close relation between humans and pigs in an environment with poor hygiene and sanitation, including consuming undercooked pork (using hot stones) contributes significantly to the spread of taeniasis/cysticercosis in Papua. Margono *et al.*, (2006) reported that the number of regencies having taeniasis/cysticercosis cases in Papua increased from one district (Paniai) in the 1970's to four districts (Paniai, Jayawijaya, Manokwari, dan

Table 2. Sero-positive immunoblot of 201 pig samples in 11 villages of Jayawijaya, Papua

No.	Villages	No. of serums	Immunoblot	
			Positive (%)	Negative (%)
1.	Waona	25	5 (20.0%)	20 (80.0%)
2.	Hubikosi	30	3 (10.0%)	27 (90.0%)
3.	Honelama	15	3 (20.0%)	12 (80.0%)
4.	Wesaput	26	1 (3.8%)	25 (96.2%)
5.	Kurulu	34	3 (8.8%)	31 (91.2%)
6.	Kama	12	2 (16.7%)	10 (83.3%)
7.	Wamena	16	0 (0.0%)	16 (100%)
8.	Pasar Baru	5	0 (0.0%)	5 (100%)
9.	Hom-hom	4	0 (0.0%)	4 (100%)
10.	Potikelek	21	0 (0.0%)	21 (100%)
11.	Holima	21	0 (0.0%)	13 (100%)
Total	201	17 (8.5%)	184 (91.5%)	

Source: Margono *et al.* (2005)

Nabire) in the last ten years. It is also due to the fact that the local inhabitants who migrate from one district to another also bring their pigs along together with their unhygienic habits.

PREVENTION AND CONTROL OF CYSTICERCOSIS IN BALI AND PAPUA

As for any endemic country, theoretically the prevention and control of cysticercosis and taeniasis should be easy, but the problem in Bali and Papua remains neglected. It is in part due to the lack of information and public awareness about the danger of the disease, besides no accurate data are available about the prevalence of cysticercosis and its distribution in animal. Data are very important to understand the source of disease transmission, so an integrated and sustainable program to control the disease can be planned. On the other hand, a limited number of skilled personnel especially in laboratory work and lack of laboratory facilities are other constraints that have hindered collection of comprehensive epidemiological data. According to Suroso *et al.*, (2006) control of the disease in Indonesia is not a priority in the health or veterinary sectors. Besides, enforcement of meat inspection regulations and procedures is lacking especially in remote areas where pigs and cattle are mostly slaughtered privately. There are no slaughterhouses available in most of these areas.

According to Juyal *et al.*, (2008), the control and prevention of cysticercosis in Asia is a difficult task because of local inhabitants' habits and traditions. Prevention can be done by giving information on the danger of the disease to the public, by improving the sanitation and the facility for disposal of human feces. Cooking well the meat is an effective prevention. *Cysticercus* will die if cooked at 45-50°C temperature for 1 – 1.5 hours or until the meat turns grey. *Cysticercus* also dies by cooling in below -20°C. Cooling in 10°C for more than four days has been reported to be effective enough, but this method requires extra cost (Juyal *et al.*, 2008).

Education for awareness about the danger of cysticercosis plays an important role to control cysticercosis/taeniasis. The fact found in Bali and Papua shows eventhough the spread is already known, some local people still practice their habits that enhance the development and spread of the disease. People in Bali like to consume red or raw *lawar*, whilst people in Papua

like to consume pork that is cooked by hot stone. And also there are a lot of people that defecate in any place although they have toilet.

According to Willingham and Engels (2006) treatment of porcine cysticercosis cases helps reduce the burden of disease. Both praziquantel and albendazole given orally have been found effective for treating porcine cysticercosis but involve multiple dosing making them impractical for large-scale control programs. Sub-cutaneous injections of inexpensive albendazole sulphoxide, 15 mg/kg daily for eight days, has been found 100% effective for killing muscle cysts but less effective at killing brain cysts in pigs though again it requires multiple doses (Gonzales *et al.*, 1995; Peniche-Cardena *et al.*, 2002; Willingham and Engels, 2006).

Several researches reported that vaccination to pigs may eventually prevent infection of cysticercosis in human. According to Lightowers (2010) over the past decade research has been undertaken to develop practical vaccines for use on pigs to prevent transmission of *T. solium*. The most effective of these vaccines being in controlled experimental trials has been the TSOL 18 vaccine. Most recently, TSOL 18 has been proven to be highly effective against naturally acquired infection with *T. solium* in pigs (Lightowers, 2003; Gonzalez *et al.*, 2005; Lightowers, 2010). Application of TSOL 18 together with a single treatment of pigs with oxfendazole achieved complete elimination of transmission of the parasite in the pigs involved in the field trials (Assana *et al.*, 2010). This strategy can be tested on livestock in Bali and Papua.

Furthermore several things to be noted for eradication of cysticercosis/taeniasis in Bali and Papua are as follows: 1) implementation of active case finding (active surveillance) and treatment of tapeworm carriers; 2) sustainable public health education; 3) establishment of a system to check the quality of pork/beef and determine the distribution of infected animals and strengthening of laboratory capacity; 4) efforts to motivate provinces or districts should be implemented in developing the strategic plan to control of the disease; 5) given the considerable differences in culture, religion, level of education, socio-economic status, daily habits and behavior etc., control programs must be adapted to the local situations.

CONCLUSIONS

Cysticercosis remains a serious neglected problem in Bali and Papua mainly due to poverty and ignorance. The control and prevention of cysticercosis in Bali and Papua are a difficult task because of local inhabitants' habits and traditions. Prevention can be done by giving information on the danger of the disease to the public, by improving the sanitation and the facility for disposal of human feces. Education for awareness about the danger of cysticercosis plays an important role to control cysticercosis/taeniasis. The fact found in Bali and Papua shows even though the spread is already known, some local people still practice their habits that enhance the development and spread of the disease. People in Bali like to consume red or raw *lawar*, whilst people in Papua like to consume pork that is cooked by hot stone. Sustainable control programs for cysticercosis infections in Bali and Papua must aim to both decrease the supply of infected meat to consumers and prevent environmental contamination with parasite eggs.

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