The current status of neurocysticercosis in Eastern and Southern Africa

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Abstract

Some information has been documented on the epidemiology of neurocysticercosis in Eastern and Southern Africa through the monitoring of hospital-based patients with neurocysticercosis, community-based serological surveys of particular socio-economic groups of people and surveys of porcine cysticercosis. Studies have revealed that non-pork eaters have as great a chance of infection as a pork eater, the Xhosa-speaking people of the Eastern Cape Province have the highest prevalence of cysticercosis/taeniosis in South Africa probably due to the common practice of free-range pig farming and the lack of sanitation in these areas. Several studies have revealed high prevalence rates in children and interestingly, patients with active cysts suffering from epilepsy. A startling mode of transmission is where self-trained healers use Taenia segments either for benevolent (e.g. in the treatment of severe intestinal tapeworm infections) or malevolent (evil) purposes (e.g. women ‘poisoning’ an unfaithful husband or lover by adding the contents of Taenia solium segments to beer).

The current status of neurocysticercosis in Eastern and Southern Africa as well as ultimate elimination of taeniosis/cysticercosis.

1. Introduction

The purpose of this paper is to review the available information on the epidemiology of neurocysticercosis in Eastern and Southern Africa. Prospects for diagnosis, treatment and control, as well as ultimate elimination of taeniosis/cysticerc-
crosis in humans and pigs are reviewed elsewhere (Allan et al., 2003; Dorny et al., 2003; Flisser et al., 2003; Garcia and Del Brutto, 2003; Gonzalez, 2003; Lekule and Kyvsgaard, 2003; Nash, 2003; Sarti et al., 2003).

When humans ingest the eggs of the zoonotic pork tapeworm, *Taenia solium*, because of environmental contamination from tapeworm carriers (e.g. food handlers, unwashed vegetables and fruits), cysticercosis may develop in their tissues and organs. When cysticercosis develops in the brain and spinal cord of either humans or pigs the condition that arises is known as neurocysticercosis (NCC).

Approximately 2.5 million people worldwide carry adult *T. solium* (Burneo and García, 2001). Conservative figures mention 50 000 deaths every year due to NCC and no less than 20 million people infected with cysticerci of *T. solium*. According to the International League Against Epilepsy, cysticercosis is probably the single most common cause of acquired epilepsy in the developing world, where prevalence rates of active epilepsy are twice those of the developed countries (Del Brutto et al., 2001). It is also a growing problem in industrialised countries because of immigration of tapeworm carriers from areas of endemic disease (Burneo and García, 2001). Globally, NCC is considered to be the most common parasitic disease of the nervous system (Burneo and García, 2001).

2. Prevalence in Eastern and Southern Africa

2.1. South Africa

In South Africa the actual prevalence and incidence of human cysticercosis/taeniosis is not known. Records of intestinal taeniosis from faecal surveys in KwaZulu–Natal reveal prevalences from <1 to 16.0% (C.C. Appleton, pers. comm., 2002). The occurrence of *T. solium* infections amongst these can be gauged from an autopsy-based study by Elsdon-Dew (1964) at King Edward VIII Hospital, Durban. This showed that adult *T. solium* infections were rare compared to those of *Taenia saginata* at a ratio of 1:39. The average number of worms was two and dual infections were noted. Prevalences for cysticercosis have been related to the area of the country the patients originate from and their race group. Heinz and MacNab (1965) investigated the incidence of cysticercosis in rural and urban Africa. Their studies revealed that there is a considerable incidence of human and porcine cysticercosis in South Africa and that when comparing all pork eaters and non-pork eaters infected with cysticercosis it became evident that a non-pork eater has as great a chance of infection as a pork eater. Of 1811 black South Africans studied, 8.5% were positive for cysticercosis. They also showed that the Xhosa-speaking people of the Eastern part of the Cape Province, including the Transkei, had the highest prevalence of antibodies to *T. solium*. Based on their investigations, Heinz and MacNab (1965) categorised prevalence rates in Africans as follows: low prevalence (0.7–2.4%) included the following population groups, urban Africans, Venda, Lemba and Zulu. Moderate prevalence population groups (6.7–10.8%) included the Batswana, Basuto, Shangaan, Tsonga and Swazi; and high prevalence population groups (20.4%) included residents of the Transkei (Pondo, Pondomisa, Xhosa, Fingo and Baca). No sero-positives were found amongst 78 Bushmen from the Kalahari in Botswana. Thus, cerebral cysticercosis is estimated to be twice as common among the people of the Transkei as compared with other race groups. We have no reason to contest Heinz and MacNab’s (1965) conclusion that in South Africa as a whole, prevalences of up to about 10% occur in the rural population but that this rises to over 20.0% in certain areas, notably the Transkei. These high prevalences are thought to be related to the common practice of free-range pig farming in Transkei and in the neighboring former homeland area Ciskei (Campbell and Farrell, 1987). The Thaba N’chu area of Eastern Free State may be another area of high prevalence (M. Pammenter, pers. comm., 1984; S. Meyer, pers. comm., 2002). In some rural areas of Limpopo Province pigs are regarded as environment friendly because of their neat habit of tidying up human faeces (Kriel, 1997).
The identification of the Transkei as probably the area of highest transmission in South Africa led to several additional studies in this region but few in other parts of the country. In a retrospective study conducted over a 15-year period from 1975 through 1989 at Groote Schuur Hospital, Cape Town, 239 patients with NCC were identified by computerised tomography. More than 88.0% of these patients were black (presumably African) people almost all originating from the Xhosa-speaking areas of Eastern Cape Province (i.e. former homeland areas of Transkei and Ciskei) (Thomson, 1993). For the purpose of this paper, the authors assume that earlier reports of blacks in the former Transkei and Ciskei would today be referred to as Africans. Of these 4.1% were asymptomatic and 51.5% were less than 13 years old. In these rural areas free-range pig farming is practiced and sanitation is largely non-existent. In these rural areas free-range pig farming is practiced and sanitation is largely non-existent. In this study, seizures were by far the most common clinical manifestation followed by raised intracranial pressure. Initially more children than adults were diagnosed with NCC but later, according to Thomson (1993), the number of adult patients diagnosed increased possibly due to the increased influx of black labourers into the Western Cape. Schutte (1985) agreed with the earlier estimate by Heinz and MacNab (1965) by suggesting that up to 8% of rural blacks were infected with parasitic cysticercosis and in certain high prevalence areas the figure may be as much as 20%. Pammenter and Rossouw (1987) found a cysticercosis prevalence of 5% in patients at King Edward VIII hospital while earlier Proctor et al. (1966) had reported prevalences at the same hospital of 5% in randomly selected African patients, 2% in local African blood donors and 2% in randomly selected Indian patients. These prevalence rates from KwaZulu-Natal are in agreement with Heinz and MacNab’s (1965) categorization scheme. Mafojane (1994) diagnosed 13 patients (0.006%) with NCC out of a population of 233,260 in Attridgeville-Mamelodi townships, Gauteng.

Shasha et al. (1986) analysed details of 141 cases diagnosed with NCC at King Edward VIII and Wentworth Hospitals in Durban. Like Heinz and MacNab (1965), they did not find any significant differences between the prevalences of active and inactive disease in either males or females while the age frequency distribution of active infections suggested two peaks in prevalence, viz in the 5–9 and 20–24 year age groups. These authors suggested, as did Heinz and MacNab (1965), that all age groups are likely to be susceptible and these peaks might therefore be artefacts. Infection might commonly occur at an early age as indicated by the cases seen at Groote Schuur Hospital where 51.5% of NCC patients were children (Thomson, 1993). Thomson et al. (1984) reported 61 children with cerebral cysticercosis diagnosed by computerized tomography (CT) scanning or serology. 43% of them presented with epilepsy, 34% had raised intracranial pressure, 13% had meningo-encephalitis, 10% had hydrocephalus caused by obstruction to CSF flow and two died.

Pammenter and Rossouw (1987) studied two groups of school children (1352 in total) in the former Transkei (736) and KwaZulu-Natal (677) by comparing serum cysticercus antibody levels and found that the seropositivity in the Transkei area was 10 times as high as that in Natal. After correcting for the assumed sensitivity and specificity of their test these authors concluded that the prevalence of cysticercosis in the Transkei community was a relatively low 2.5% and even lower in the KwaZulu-Natal community, 0.2%. However, extrapolation of the prevalence of 2.5% for the Transkei community to the region as a whole led them to estimate that there were some 112,000 infected people living there—though they acknowledged that this was probably an underestimate! Later, Shasha and Pammenter (1991) measured antibody levels in 1352 school children from two rural areas of Transkei and again found a relatively low seropositivity rate of 5.5%. Whether this decline in prevalence rates in Transkei from the levels reported in the 1960s is real and if so, whether it is localized or reflects the region as a whole, is not known.

A recent online article, Foyaca-Sibat (2002), has however, raised concern about the still high prevalence in children in Transkei. He noted that as a result of this and the often long lag period before the onset of symptoms, increasing rural–urban migration in South Africa will continue to lead to NCC being diagnosed in developed areas
such as Gauteng where people do not keep free-ranging pigs. As mentioned previously, the study of NCC patients presenting at Kalafong Hospital from Atteridgeville and Mamelodi townships (Pretoria) by Mafojane (1994) revealed a very low prevalence of 0.006%. Although only people born in the Pretoria area were included, the source(s) of infection could not be determined largely because of the high mobility of the people.

The prevalence or incidence of epilepsy associated with T. solium in South Africa is also unknown. Heinz and Klintworth (1965) examined the role that cysticercosis plays in the aetiology of epilepsy and revealed that 16% of 200 mineworkers repatriated because of epilepsy, were positive for cysticercosis. They also found that 12.5% of black adult epileptics had positive serological tests for cysticercosis. Naidoo et al. (1987) did CT scans on 70 black patients with epilepsy seen at Wentworth Hospital, Durban, and found cerebral cysticercosis in 30% with 12.9% of these patients suffering from headaches and one with headaches followed by stupor. Nine of these patients suffered from epilepsy (69.25%), two had psychiatric disorders, one suffered from headaches and one with headaches had active NCC and three had inactive disease. Nine of these patients suffered from epilepsy (69.25%), two had psychiatric disorders, one suffered from headaches and one with headaches followed by stupor.

In summary, although the Eastern Cape (especially the former homelands of Transkei and Ciskei) has the highest prevalence of cysticercosis/taeniosis, all the provinces of South Africa have foci but the prevalence depends on pig-rearing methods, meat control measures, and socio-economic conditions in the area. In spite of this, only scant information is available concerning porcine cysticercosis in the country. Thus far the only information about pig infection is available from two post-mortem surveys at slaughterhouses across the country. Viljoen (1937) reported prevalence values of 0.5–25.1% while Heinz and MacNab (1965) reported somewhat lower values of 0–9.1%. Schutte (1985) rightly mentions that information on the prevalence of porcine cysticercosis comes from abattoirs and this may not be a true reflection of the situation in rural areas.

Kriel and Joubert (1996) and Kriel (1997) reported alarming information whereby unqualified, self-taught healers (so-called evil sorcerers or 'baloi') use Taenia segments and their contents as treatment in cases of severe intestinal tapeworm infections. Taenia segments or their pulverized contents are added to the medicinal mixture which also contains so-called strengthening ingredients. Besides this practice, the malevolent use of T. solium by women to punish their unfaithful husbands or lovers is also common. The contents of T. solium segments are added to beer as punishment.

2.2. Zimbabwe

T. solium has also been reported in Zimbabwe (Merle, 1958). In humans, calcified cysticerci are not uncommon incidental findings on chest or limb X-rays and NCC is an occasional diagnosis at surgery for intra-cranial or spinal lesions (Rachman, 1970). A study in Bulawayo reported calcified Cysticerci in 11% of patients who presented with seizures and in whom thigh X-rays were taken (Rachman, 1970). In one hospital survey in
Harare, 12% of epileptic patients seen in Harare were found to be positive for *T. solium* on serological testing (Mason et al., 1992). The prevalence was higher in men (18%) than in women (7%). Ndhlovu (1997) reported an uncommon presentation of cysticercosis that manifested as a sudden death. Recent evidence suggests that *T. solium* is an emerging problem in small-holder communities where the prevalence of porcine cysticercosis in these communities has increased from 2.7 to 28.6% during the period 1995–2002 (S. Mukaratirwa, pers. comm., 2002).

2.3. Zambia

In Zambia, preliminary studies during 2000 revealed that cysticercosis is widespread in the country with over 20% of pigs for sale and slaughter at a Lusaka market found infected and there are recent reports of people manifesting the disease in the form of subcutaneous nodules (Phiri et al., 2002, 2003). Also, 8.2 and 5.2% of pigs in small-holder communities of Southern and Eastern Provinces, respectively, have been shown by lingual examination to be infected with cysticercosis (Phiri et al., 2002). This suggests the presence of human tapeworm carriers and a high risk of human cysticercosis in the surveyed areas as well as in urban centers where pigs from rural areas are increasingly sold, slaughtered and consumed.

2.4. Mozambique

Serra (1968) reported the first post-mortem case of NCC in Mozambique while the first clinical case of NCC was reported at Maputo Central Hospital in 1999 (Santos et al., 1999). In a cross-sectional seroepidemiological study on humans conducted in Tete City, 32 out of 157 sera (20%) presumably from epileptic cases, were found positive by ELISA test (Vilhena and Bouza, 1994). Another study on epileptic patients conducted in northwest Tete Province found that 14 out of 80 (17.8%) were positive for cysticercosis by ELISA testing (S. Afonso, pers. comm., 2002). A similar serological survey conducted at Maputo’s Central Hospital found a sero-positivity rate of 12.1% (59 out of 489 patients) (Vilhena et al., 1999). In Mozambique, abattoir records indicate that porcine cysticercosis is present in all provinces of the country. A seroprevalence study in 11 districts of Tete Province using antibody-detecting ELISA indicated a range of 6.5–33.3% of pigs infected in the different districts of that province (Afonso et al., 2001).

2.5. Madagascar

Cysticercosis caused by *T. solium* was first reported in humans in Madagascar by Andriamianandro et al. (1969). Surveys of adult epileptics have indicated 22.3–36.0% to be positive serologically for cysticercosis (Michel et al., 1993; Andriantsimahavandy et al., 1997) while 17.6% of epileptic children have been found to be positive serologically for *T. solium* infection (Grill et al., 1996). There are reports of 18% of the population demonstrating antibodies to *T. solium* (Michel et al., 1993). In addition to epilepsy, cysticercosis has also been noted as a cause of ocular cysts leading to blindness (Auzemery et al., 1996).

2.6. Tanzania

*T. solium* has been reported as an emerging and increasing problem in small-holder pig populations in the Northern and Southern Highlands of Tanzania since the mid-1980s when it was first detected in pigs exported to Kenya (Boa et al., 1995; Nsengwa, 1995; M. Boa, pers. comm., 2002; H. Ngowi, pers. comm., 2002). Coincidentally ‘epilepsy’ in humans, of unknown aetiology, has also increased considerably during the past decade in Tanzania (C. Mbuya, pers. comm., 1999). Interviews of inhabitants in rural, pig keeping, small-holder communities indicate that epilepsy is an increasing problem in these areas (H. Ngowi, pers. comm., 2002; M. Boa, pers. comm., 2002). A recent questionnaire survey conducted in the Northern Highlands indicated that 58.2% of respondents knew of someone in their community with epilepsy and 35% knew of someone with taeniosis.

In recent years, pig keeping and pork consumption have increased considerably in many areas of Eastern Africa. Porcine cysticercosis was first detected in the region in the late 1980s when
Tanzanian pigs from the Northern Highlands district of Mbulu were exported to Kenya and were found to be heavily infected at slaughter. A retrospective study of slaughter slab records from Mbulu district in Tanzania from 1985 to 1989 indicates a prevalence increasing from 0.4 to 4.9% during that time (Nsengwa, 1995). This was further substantiated in 1993 by a post-mortem survey of pigs slaughtered at different slaughter slabs in the Northern Highlands, which indicated that 4.5–37.7% were infected, with the vast majority of these pigs originating from Mbulu (Boa et al., 1995). A recent ante-mortem survey involving lingual examination of pigs in villages of Mbulu district revealed an overall district prevalence of 17.4% (n = 770), with a prevalence of the individual villages (n = 21) ranging from 3.2 to 46.7% (Ngowi, 1999). Boa et al. (2001) interviewed local farmers (n = 231) in Chunya district and found that 94% of these respondents were ignorant of the mode of transmission of T. solium taeniosis/cysticercosis and 45.2% allowed their pigs to roam about scavenging for food especially in the post-harvest period. Many respondents reported that they knew of epileptics and tapeworm carriers in their villages.

2.7. Kenya

T. solium has not been considered to be endemic in Kenya for several decades. However, recent surveys indicate that T. solium is emerging as a problem in small-holder pig keeping communities of southwestern Kenya where ante-mortem lingual examination in different locations in the area have indicated at least 10–14% of pigs surveyed to be infected (S. Githigia, pers. comm., 2002). The situation is being attributed to poor sanitation and the relaxation of enforcement of regulations concerning the management of pigs (i.e. no free-range pig keeping). Two cases of NCC in humans were recorded in 1986, one was a patient at Nairobi hospital while the other was a resident of Kakamega district in the southwestern part of the country. Both cases had cerebral cysts with one case also having an ocular cyst (R.F. Ruberti, pers. comm., 2002). According to the Annual Reports of the Ministry of Health (MOH), the prevalence of human taeniosis in rural areas is estimated to be 2%. However, this figure is higher in some areas such as Busia District Hospital where records indicate a prevalence between 4 and 10% in one division where free-range pig keeping is practiced (S. Githigia, pers. comm., 2002; MOH annual report, Busia District Hospital, 2001). Cases of epilepsy are also higher in this district. A questionnaire survey conducted in two divisions in this district showed an association between free-range pig keeping and cases of epilepsy in the homesteads (S. Githigia, pers. comm., 2002).

2.8. Uganda

Human cysticercosis has not been noted as a problem in Uganda, however, recent reports indicate that porcine cysticercosis is emerging as a serious problem particularly in rural areas such as Lira, Apac and Nakasongola districts (M. Saimo and G. Lubega, pers. comm., 2002). A post-mortem survey conducted in northern Uganda in 1999 indicated 34–45% of pigs slaughtered were infected (M. Saimo and G. Lubega, pers. comm., 2002). Uganda reports the largest number of non-commercially-raised pigs in the Eastern and Southern Africa region and pork consumption is extremely popular in the country. Given the high porcine cysticercosis prevalence rate in areas bordering Uganda in Tanzania and Kenya and the large rural pig population, the public health risks of NCC should be considered seriously.

3. Discussion

Although there is more evidence from South Africa on the epidemiology of NCC when compared with the other Eastern and Southern African (ESA) countries, it is clear that there is a high prevalence of porcine cysticercosis throughout the region. Both this disease and NCC already pose a serious public health risk in some of these countries and are creating an ‘emerging’ problem in others. The identification of ‘emerging’ cysticercosis-related problems in some countries is important and should be brought to the attention of the
veterinary and public health authorities. This will give them the opportunity to draft new legislation allowing for statutory control measures to be put in place.

The availability of better epidemiological information on cysticercosis in South Africa may be attributed to a greater awareness and more resources than elsewhere. For example, South Africa has 214 computed axial tomography (CAT) scanners in working condition and 111 neurologists. Zimbabwe is second with 26 machines while the other ESA countries have only two to four, as well as fewer than two specialists per country (R.C. Krecek, L.M. Michael and N. Maingi, pers. comm., 2002).

Geographically, the former Transkei and Ciskei of the Eastern Cape Province have been reported to have the highest prevalence of NCC in South Africa. Historically, they were designated homelands and the infrastructure and services were not developed as well as in other areas of the country. Today, though the Eastern Cape Province is one of the poorest, economic as well as other initiatives are being directed to it. Small-scale pig raising with free-ranging pigs is popular in the Eastern Cape and pork is often the cheapest meat available. Other contributing factors include poor sanitation, poor pig management, poor meat inspection and control, and cultural factors and human behavior (Kriel, 1997). Other provinces of South Africa have foci of NCC and the relevant information needed to understand the epidemiology. In spite of this, only scant information is available concerning porcine cysticercosis in the country. As mentioned in this paper the information on the prevalence of porcine cysticercosis comes from abattoirs and is unlikely to be a true reflection of the situation in rural areas.

Some evidence exists for NCC in Zimbabwe, Mozambique and Madagascar but little or none in Zambia, Tanzania, Kenya and Uganda though the presence of porcine Cysticercosis suggests that T. solium is endemic.

Juvenile cases are common in South Africa which is in contrast to the late-onset infections seen in Latin America and this represents a distinctly different trend. Usually epilepsy is considered to be caused by calcification of cysts. However, reports from South Africa differ and it is not uncommon to observe epilepsy in patients with active cysts. Campbell and Farrell (1987) reported coal miners with epilepsy who were found to have only active cysts.

Those not eating pork are as at much risk of contracting cysticercosis as those consuming pork (Heinz and MacNab, 1965). This has also been reported in Tanzania (Phiri et al., 2002).

More information is required to determine what needs to be done. Some contributory studies to this would include: community based studies on both human and porcine cysticercosis, risk assessment studies, impact assessment on both health and agriculture and whether NCC be considered to be made a notifiable disease.

Constraints include a lack of community based surveys and especially lack of community based ante-mortem porcine surveys in the entire ESA region. A study which has been funded by the United States Agency for International Development will address the epidemiology of T. solium in emerging farming areas and areas where NCC has been reported in South Africa. This will be the first community-based survey for cysticercosis in pigs in an emerging farming community in this country since previously most information has been based on hospital and slaughterhouse surveys. This will be accomplished by: a community-based survey of live pigs by lingual examination and a comparison of three biotechnological diagnostic tests to determine the presence of T. solium cysticerci, inspection of slaughtered pigs in the study sites and collection of T. solium cysticerci from infected carcasses and a questionnaire survey of pig-owning households to provide information on pig husbandry practices, pork consumption, sanitation and people’s knowledge of T. solium. The results of such a study will provide essential information for formulating a national surveillance and control plan for T. solium while also providing evidence for decision and policy makers to use when making priority assessment with regard to allocation of resources. Such a programme would be expected to lead to improved pig health and production, reduce the occurrence of this disease in humans and promote agricultural development in general. This could serve as a
model for other ESA countries. A lack of awareness by medical community and government authorities about the parasite and its presence in the region, lack of facilities, equipment (CT scanners), trained personnel, medical services in rural communities, lack of diagnostic techniques (need technology transfer) and a lack of resources and widespread knowledge and regional approach are all challenges.

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References


